Safe-Stop® 180 TMA

(Model 9182)

Compact TMA That Meets NCHRP 350, TL-3

Installation/Operation

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Saving Lives By Design

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Safe-Stop® 180 TMA

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Important Introductory Notes

This manual contains important information on the Safe-Stop 180 TMA (Truck Mounted Attenuator). Proper installation and operation of the Safe-Stop 180 TMA is essential to assure maximum performance. Take the time to review this entire manual thoroughly prior to installing and/or operating the Energy Absorption Systems, Inc. Safe-Stop 180 TMA.

If you need additional information, or have any questions about the Safe-Stop 180 TMA, please call **Energy Absorption Systems' Customer Service Department at 1-888-32-ENERG.**

RETURN GOODS POLICY

Before returning any goods for credit please contact Energy Absorption Systems Inc. Customer Service Department at 1-888-32-ENERG or your local distributor for proper instructions.

Functional Description

The Safe-Stop 180 TMA is a Truck Mounted Attenuator designed to reduce the risk of injury to passengers of an errant vehicle and to the driver of the truck to which the system is attached. The system mounts on the rear of a truck and may be used in stationary applications, such as a truck blocking a work zone and mobile operations, such as striping, sweeping, plowing, etc.

The Safe-Stop 180 TMA consists of the following basic components: a collapsible frame assembly; two crushable cartridges; a support structure; an impact face and an underride (see Figure 1).

Safety Instructions

For maximum safety, the operator should stand at the rear of the truck, on the curb side, (see Figure 2). When tilting the TMA, care should be taken to stay clear of all moving parts.

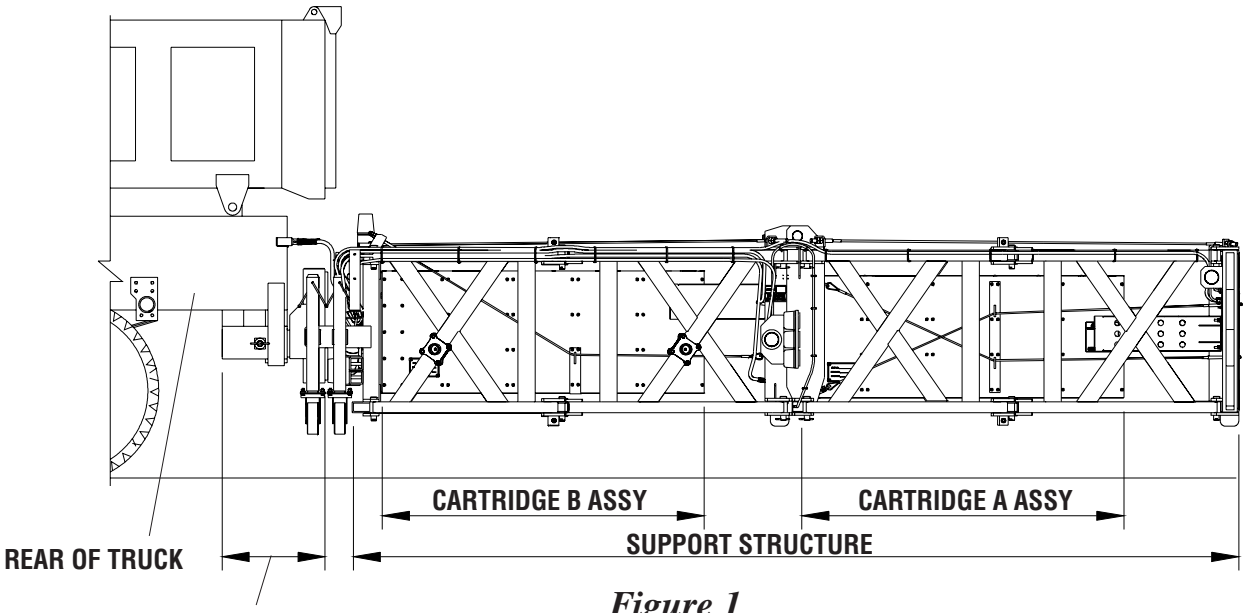


Figure 1

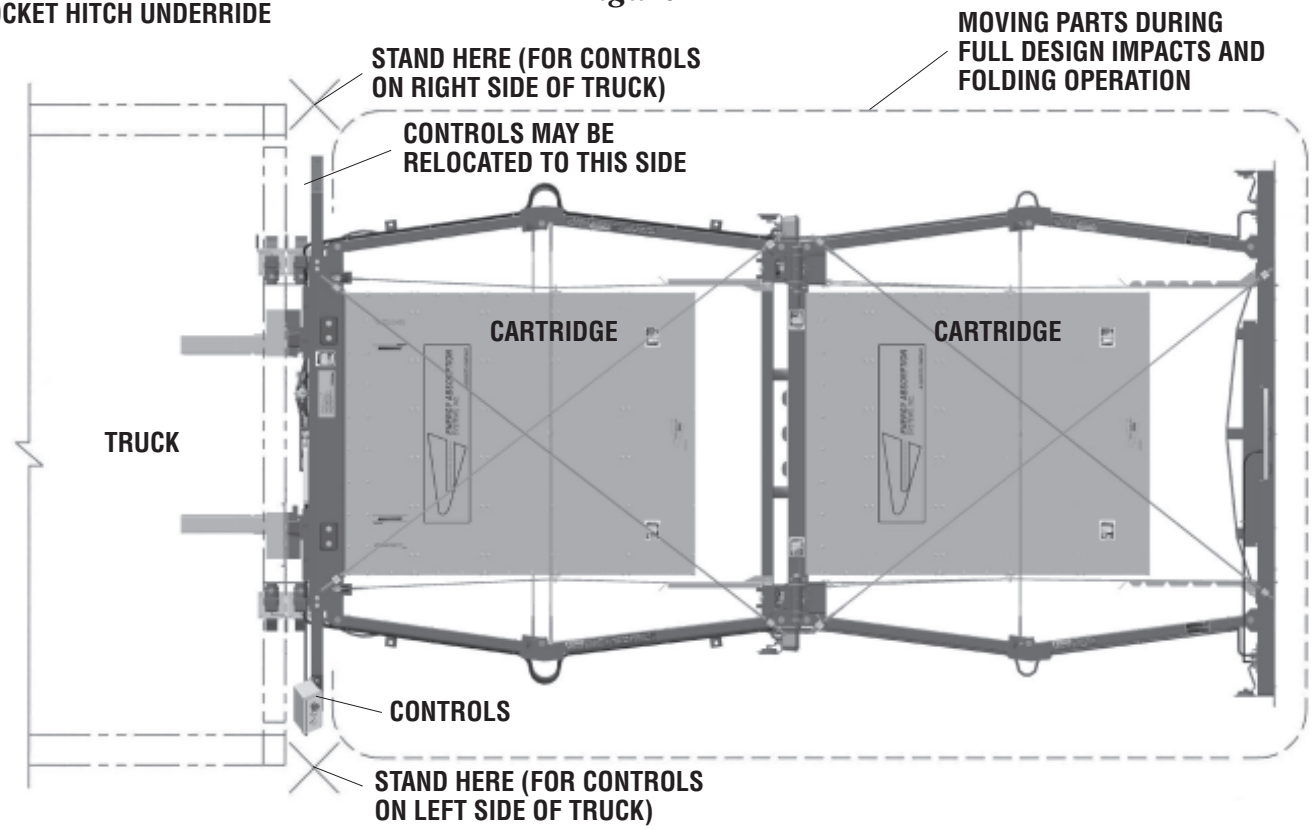

MOVING PARTS DURING FULL DESIGN IMPACTS AND FOLDING OPERATION
STAND HERE (FOR CONTROLS ON RIGHT SIDE OF TRUCK)
CONTROLS MAY BE RELOCATED TO THIS SIDE
CARTRIDGE
CARTRIDGE
TRUCK
CONTROLS
STAND HERE (FOR CONTROLS ON LEFT SIDE OF TRUCK)

Figure 2

Safety Instructions (cont'd.)

1. The TMA should be rigidly fastened to the truck. In the horizontal position, the bottom of the TMA should be 280 to 330 mm [11" to 13"] from the ground and level (see Figure 3). *The TMA should be left in the folded position whenever it is not being used as an impact attenuator. The TMA has impact absorption capacity in the folded position that has been successfully tested to NCHRP 350 Test Level 2 (70 km/h) for specified design impacts. See the "Limitations and Warnings" Section for additional information.
2. Jacks may be used to support the folded TMA when it is off the truck. The jacks must be stored while the TMA is attached to the truck. The jacks can be stored on the brackets provided on the support frame. (See Figure 3). If you are subject to vandalism, prepare another storage plan.
3. Make sure all pivot pins are in position and that all retaining pins are installed correctly (see Figure 4).

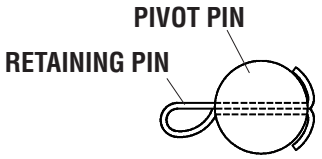


Figure 4

*The Safe-Stop 180 TMA shall be employed in the unfolded position: At **all times** while operating as either a **Barrier Vehicle** or **Shadow Vehicle**.

The Safe-Stop 180 TMA should be in the **"unfolded"** position when: Transporting short distances at a low speed, Transporting at a speed much lower that adjacent traffic, and Transporting in areas where vehicle ride characteristics and maneuverability are maintainable.

The Safe-Stop 180 TMA should be in the **"folded"** position when: Transporting long distances at a high speed, Transporting at a speed near the speed of adjacent traffic, and Transporting under conditions of compromised maneuverability typically when the large turning radius clearance needed for the extended TMA is not safe.

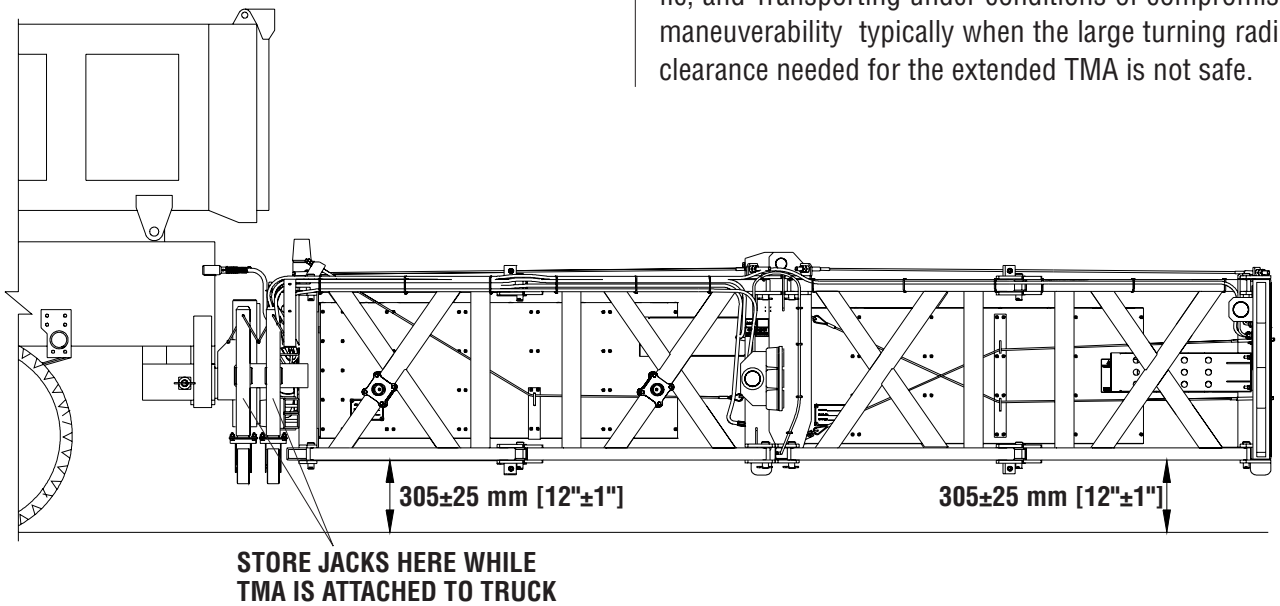


Figure 3

4. The Safe-Stop 180 TMA is designed to safely absorb a crash, and to support its own weight. Do not drag the TMA or place anything on its top: damage may result. Do not sit, stand or lean on any part of the TMA (see Figures 5 & 6).

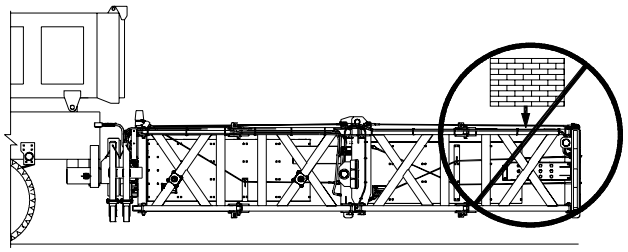


Figure 5

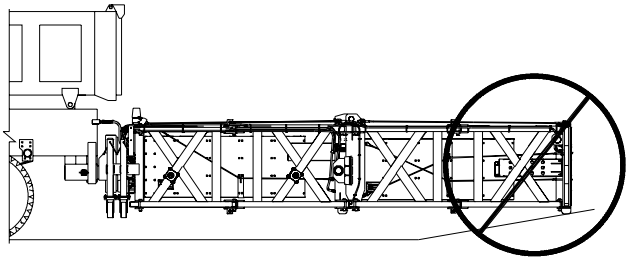
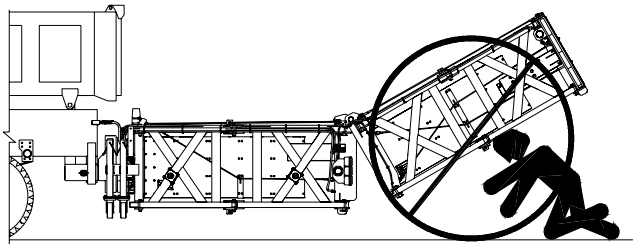


Figure 6

5. Before raising or lowering the TMA, the operator should be trained as to its proper operation. Refer to the Operation Instructions in this manual.
6. Folding the TMA provides the best maneuverability and driving characteristics. It is permissible, during restricted city driving and high-speed travel, to have the TMA folded to its 180° position. Refer to local agency policies as required for additional guidance. Unfold the system either before, or as soon as possible after, entering a job site or beginning shadow vehicle operations. Remember that it is recommended that the support vehicle be stopped for TMA folding and unfolding.
7. Be sure all persons are standing clear before folding or unfolding the TMA. Be sure the system is stopped in full folded position before allowing anyone directly behind the folded system (see Figures 7 & 9).



NO ONE TO BE ALLOWED BEHIND ELEVATED TMA

Figure 7

8. Ballast and other heavy objects MUST BE ADEQUATELY ANCHORED to the truck to prevent shifting during an impact. (The force on the tie-down straps could be 20 times the weight of the ballast.)

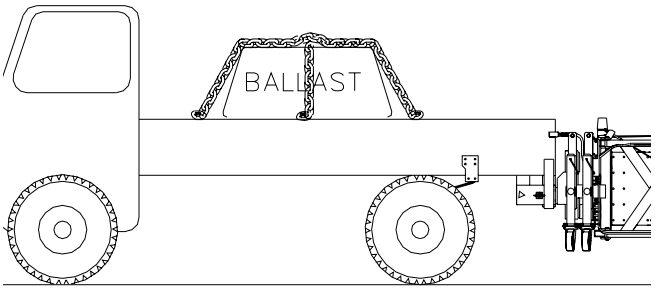


Figure 8

Safety Instructions (cont'd.)

9. The agency responsible for the truck should inspect it for adequate operator safety equipment (e.g., seat belts, head rests, etc.)
10. It is recommended that the Safe-Stop 180 TMA be mounted to trucks that weigh between 7300 kg [16,090 lbs.] and 9000 kg [19,845 lbs.] for optimum impact performance.
11. Make sure that the performance and safety of the TMA is not impaired by damage or corrosion.

WARNING!

Failure to comply with these instructions can result in improper TMA performance and possible personal injury. This TMA is intended to be used as a crash attenuator on the rear of trucks which meet the design specifications for this system.

12. Regular maintenance of the TMA is important for safe use. Refer to the maintenance section of this manual for additional information.
    - Regular inspection of frame members, cartridges and pins is necessary to ensure proper system performance.
    - Regular inspection of hoses is important. A broken or damaged hose will cause the system to quit functioning properly.
    - Keep electrical connections at the pump motor/solenoid clean to prevent arcing. Clean any hydraulic spills or leakage to prevent bodily injury, fire, etc.
13. The driver should be extra cautious while backing the truck with the TMA in the up or down position, so that injury and/or damage will not result.
14. This system is a crash cushion and is therefore used in high risk areas. Stay clear of traffic whenever possible. If an accident is to occur, even during a design impact, there may be fragments from the truck or impacting vehicle that could cause injury.
15. The hydraulic assembly was designed to fold and unfold the TMA system as described. Any other use may be hazardous to people or equipment.
    - Do not use the system to push a load.
    - Do not use the raised end of the system to support any load.
    - Do not use any part of the TMA for towing or hauling a load. This could cause the lift mechanism to malfunction, and may reduce the impact performance.
16. The system must be in the unfolded position to perform properly during an impact. Do not leave the system raised, even slightly, when on the job.
17. Be sure the truck is appropriate for attaching a TMA. See the installation section for further details

Definition-The BARRIER VEHICLE is the truck on which a TMA is mounted, while positioned upstream (towards the direction that traffic is approaching) of a work zone.

The SHADOW VEHICLE is the truck on which a TMA is mounted, which is following behind a moving operation such as striping, spraying, etc.

THE USE OF A TMA ON THE BACK OF A TRUCK WILL:

- Gradually stop the impacting vehicle*
- Protect the occupants of the impacting vehicle *
- Protect the shadow vehicle occupants*
- Reduce damage to the shadow vehicle*

WILL NOT:

- Affect the skid (roll ahead) distance of an impacted truck (see figure 9). **KEEP WORK CREWS CLEAR!**

CONTROLLING SKID DISTANCE (ROLL AHEAD):

- Skid distance is significantly increased and is less predictable for lightweight shadow vehicles
- Skid distance is reduced and is more consistent when heavier shadow vehicles are used.
- Preferred truck GVW rating is:
  9072 kg [20,000 lbs.] to 27,215 kg [60,000 lbs.]
- Recommended Curb Weight of truck is:
  7300 kg [16,090 lbs.] to 9000 kg [19,845 lbs.]

***DESIGN SPEED IMPACTS:**

- 100 km/h [62 mph] for 820 and 2000 kg [1808 and 4410 lbs.] vehicles.

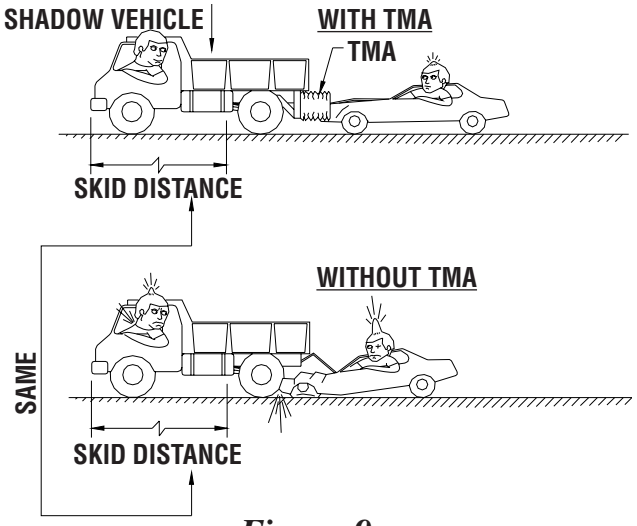


Figure 9

Installation Instructions

Read and understand all instructions before beginning installation.

The truck rating (GVW) should be 9072 kg [20,000 lbs.] min. The weight of the vehicle should be between 7300 and 9000 kg [16,090 and 19,845 lbs.] for optimum impact performance.

The system must be attached to the truck by welding parts to the frame. Do not weld forward of the rear leaf spring hangers to ensure structural integrity of frame. Use AWS qualified welders to ensure durable attachment of the TMA system. Disconnect the truck battery before any welding on truck or TMA.

The truck frame must be suitable and accessible for mounting a TMA system. If there are any questions regarding the suitability, contact the Customer Service Department for assistance.

1) Shipping list

Check the shipping list against the actual parts to make sure all items were received. Review the drawing package and familiarize yourself with the assembly and part numbers.

2) Assemble Necessary tools:

Recommended Tools

1. Welding equipment (for 1/2" plate) GMAW or SMAW
2. Cutting torch
3. Hammer
4. Drift pin or alignment pin (12" long)
5. Tape measure
6. 1/2" drive socket wrench w/6" extension
7. 1/2" drive sockets (9/16", 1-1/8", 1-1/2", 9/16" deep well)
8. Open end wrenches (9/16", 1-1/8", 1-1/2")
9. 12" crescent wrenches - (2)
10. Marking implement (pencil, soap stone)
11. Floor jack
12. Drill motor for 13/16" diameter bit
13. 13/16" diameter bit and pilot drill for same
14. Center punch
15. Torque wrench - 120 Nm [90 ft-lbs.]
16. Hydraulic fluid (use Dexron® III fluid only)* *Shipped with system
17. Forklift

Preparation

3A) Installation Must Be Performed On A Level Surface

The system's framework is very heavy and pivots in several areas. Until the framework is secured with the cables, it can swing out in an approximate 4 m [13'] radius from either side of the truck. A level surface is required to maintain control of the framework when it is being extended to its full length.

3B) Truck ballast

Use a bubble level to verify that the truck is parked on a level surface. The truck should be as close to the final driving weight as possible. If ballast must be added to achieve the 7300 kg [16,090 lbs] minimum weight, add it at this time. Ballast must be properly anchored to the truck to keep it in place during an impact. Ideally, an adequately sized truck, that requires no ballast, should be used. Because the 953 kg [2100 lb] weight of the rearward protruding TMA is supported by the back of the shadow vehicle, care must be taken not to exceed the manufacturer's published maximum axle loads. To ensure that the driving characteristics of the vehicle are maintained, the manufacturer's recommended center-of-gravity zone should also be adhered to.

4) Check for interference

Before attempting to install the underride, check for interference problems.

The System folds such that the impact face is very close to the mounting location. See Figure 32 page 28. If you are using something other than a standard socket receiver hitch underride refer to special instructions supplied with your assembly then skip to step 8.

Temporarily position the underride socket receiver under truck frame as shown (refer to Figure 12) and check for interference problems. Interference problems with tail lights, springs, dump bodies (in the up or down positions), etc., should be corrected before proceeding.

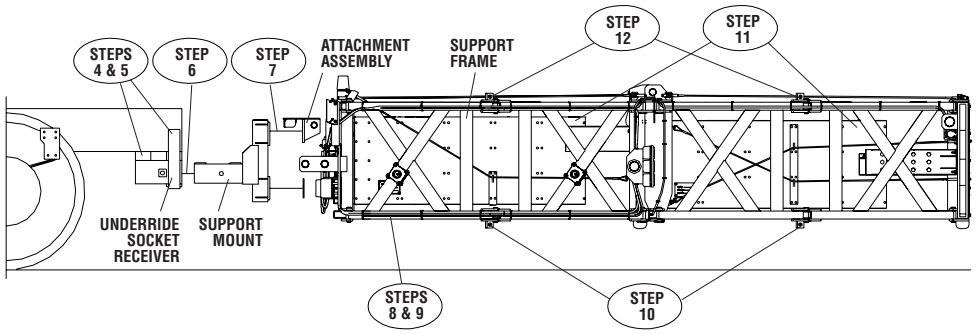


Figure 10

5) Underride Assembly

With the truck at its actual driving weight, parked on a level surface, measure the distance from the ground to the bottom of the truck frame. A distance of 711±25 mm [28±1"] is required. Spacers may be added to the bottom of the frame to achieve this height (see figure 13 and the Underride Assembly drawing on page 49).

Note: The truck's springs may settle with the weight of the TMA, sometimes, as much as 50 mm [2"]. Adjust the height to compensate for anticipated settling.

Measure from the back end of the frame forward to the rear-most leaf spring hanger, or any other obstruction on the bottom of the frame that may interfere with the socket receiver. A minimum of 305 mm [12"] is required (see the Underride Assembly drawing on page 49).

Position the socket receiver at the rear end of the frame so that the 76 x 387 mm [3 x 15 1/4"] flat bar is along the outside of the frame member and the socket receiver tube is flush with the end of frame. If spacers are required, weld them to the receiver tube and lap the spacer splices (pieces of 10 x 51 x 103 mm [3/8 x 2 x 4"] flat bar) across the socket receiver tube and spacer at the rear-most location (see underride assembly drawing). The top of the socket receiver tubes must be 711 ± 25 mm [28 ± 1"] from the level ground for proper system height (see Figure 12).

Weld the socket receiver tube to the bottom of the truck frame with the 76 x 387 mm [3 x 15 1/4"] flat bar on the outer side of the frame (see Figure 11).

Note: All welding must be performed by a welder certified to AWS D14.3-82 or AWS D1.1 in accordance with the underride drawing. Disconnect truck battery before welding.

CAUTION: The truck frame is high carbon steel. To avoid cracking, do not weld, or apply excessive heat, to the bottom flange, forward of rear-most leaf spring hangers.

Prime and paint all welded areas.

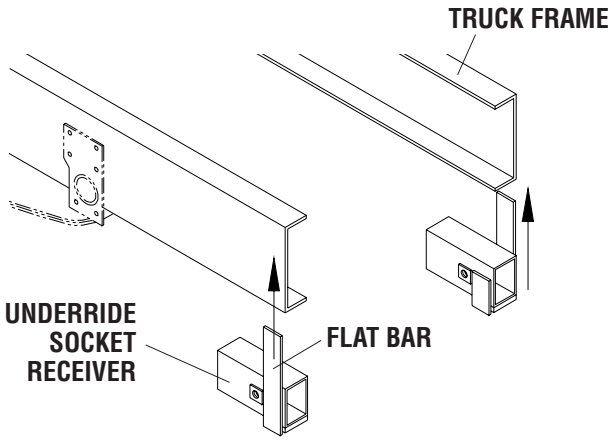


Figure 11

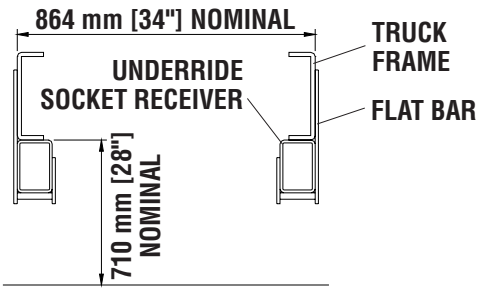
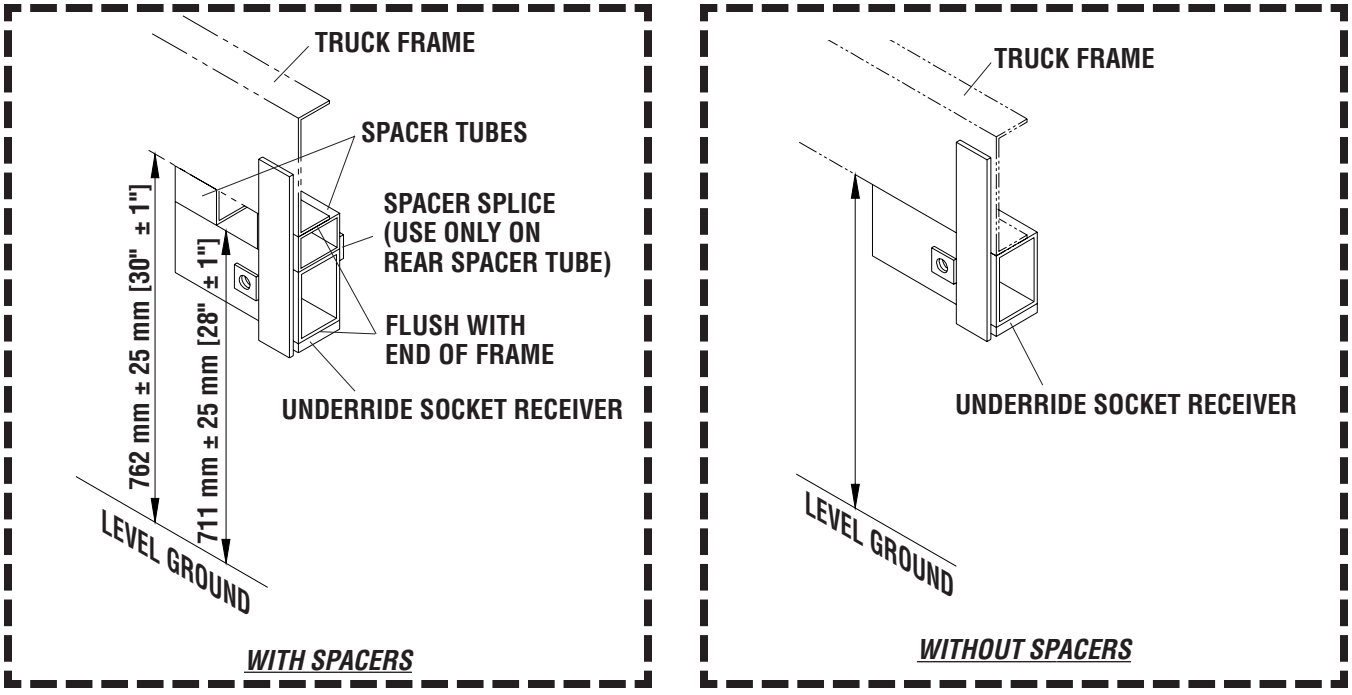


Figure 12

Installation Instructions (cont'd.)



Note: Left and right underride socket receivers must be parallel with each other and level.

Figure 13
Socket Hitch (Left Side Shown)

6) Socket Hitch Assembly

Install the socket hitches and pin them into place using the 1 x 6 ¼" hitch pins and retainer pins shipped with the system.

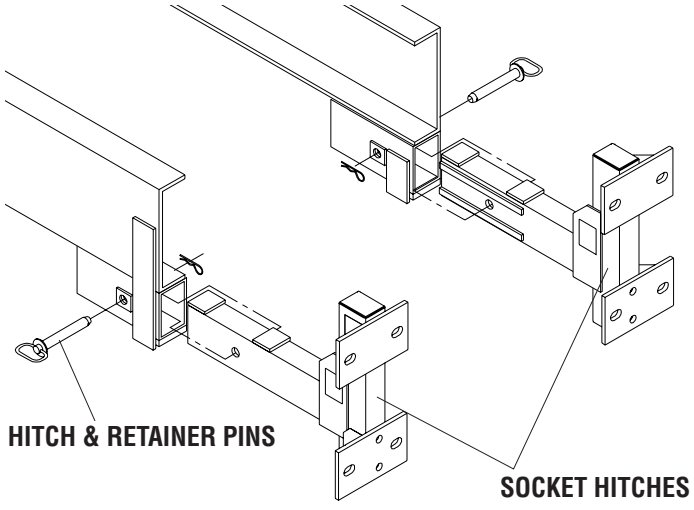


Figure 14

7) Mount the Attachment Assembly to Socket Hitches

Mount the attachment assembly to the socket hitches as shown in Figure 15. Shims are used to level the system. It is recommended that 1/2" shims be used initially. This may be adjusted once the system is assembled.

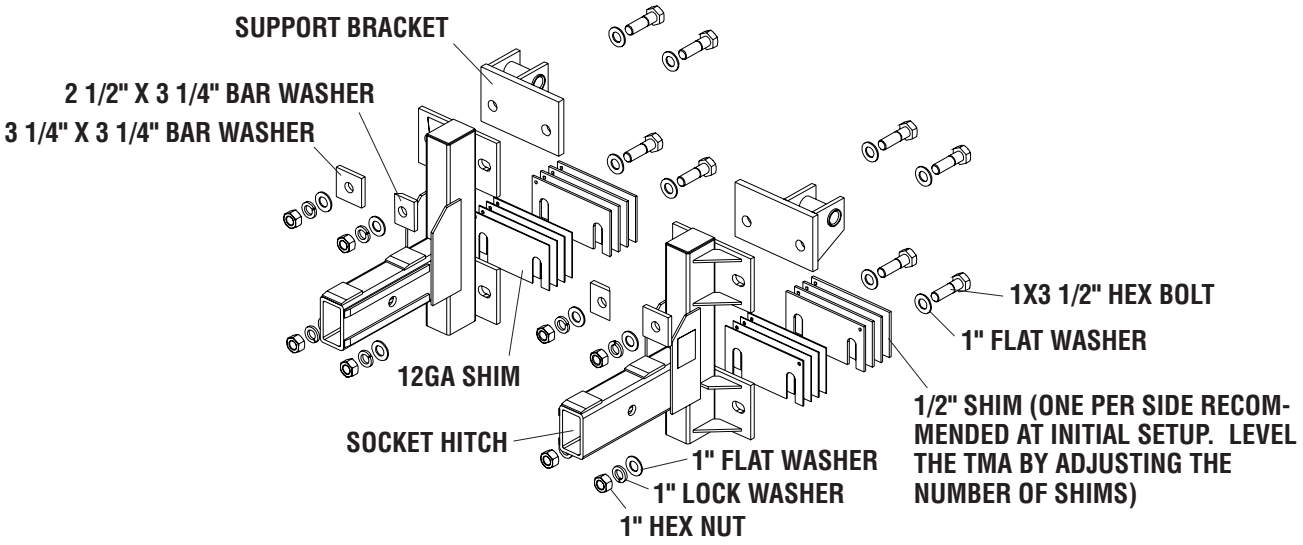

SUPPORT BRACKET
2 1/2" X 3 1/4" BAR WASHER
3 1/4" X 3 1/4" BAR WASHER
12GA SHIM
SOCKET HITCH
1" FLAT WASHER
1" LOCK WASHER
1" HEX NUT
1X3 1/2" HEX BOLT
1" FLAT WASHER
1/2" SHIM (ONE PER SIDE RECOMMENDED AT INITIAL SETUP. LEVEL THE TMA BY ADJUSTING THE NUMBER OF SHIMS)

Figure 15

8) Attach the Support Frame / Backup to the Attachment Assembly

Move the system to the truck and pin the support frame/backup assembly to the attachment assembly, as shown in Figure 16. The assembly is to be installed while frame is still collapsed with forklift slings supporting the system. Use the upper set of mounting holes for the attachment.

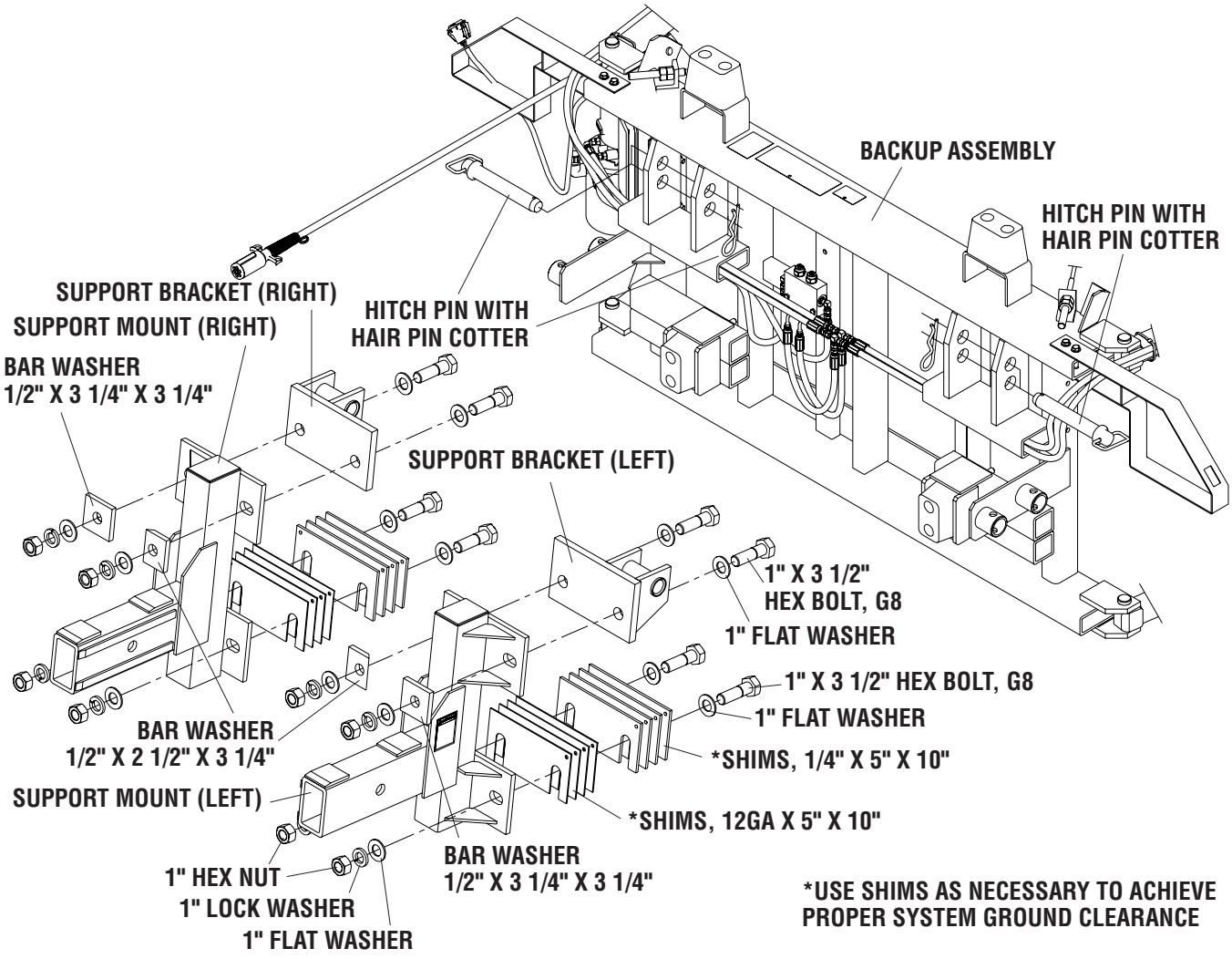

BACKUP ASSEMBLY
HITCH PIN WITH HAIR PIN COTTER
SUPPORT BRACKET (RIGHT)
SUPPORT MOUNT (RIGHT)
HITCH PIN WITH HAIR PIN COTTER
BAR WASHER 1/2" X 3 1/4" X 3 1/4"
SUPPORT BRACKET (LEFT)
1" X 3 1/2" HEX BOLT, G8
1" FLAT WASHER
1" X 3 1/2" HEX BOLT, G8
1" FLAT WASHER
*SHIMS, 1/4" X 5" X 10"
BAR WASHER 1/2" X 2 1/2" X 3 1/4"
SUPPORT MOUNT (LEFT)
*SHIMS, 12GA X 5" X 10"
BAR WASHER 1/2" X 3 1/4" X 3 1/4"
1" HEX NUT
1" LOCK WASHER
1" FLAT WASHER
*USE SHIMS AS NECESSARY TO ACHIEVE PROPER SYSTEM GROUND CLEARANCE

Figure 16

9) Extend the Support Frame

With the TMA pinned to Attachment Assembly, slowly and evenly pull the frame out to its full extent.

WARNING!
Even when supported by forklift, frame can be unwieldy. Use extreme care.

WARNING!
Until the cables are installed, the system may shift to one side.

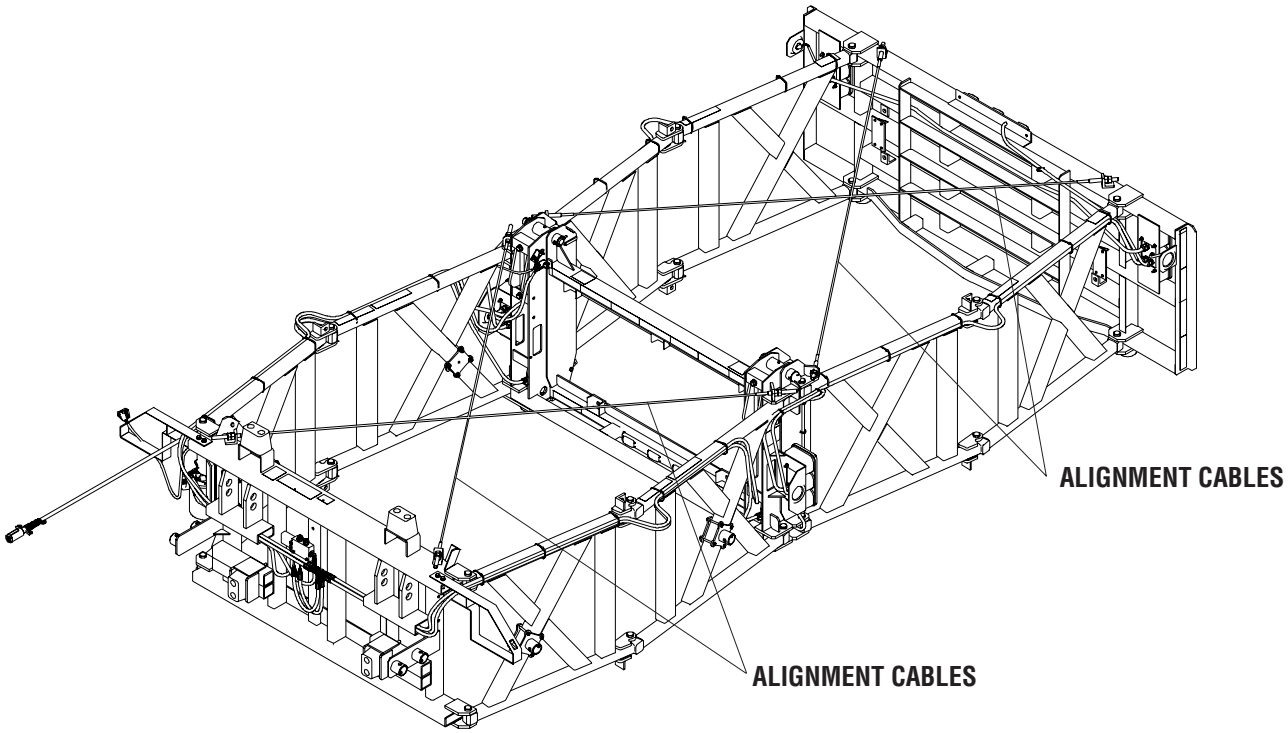


Figure 17

Installation Instructions (cont'd.)

WARNING!

For proper System performance, only use Release Cables supplied by Energy Absorption Systems, Inc. Failure to use the correct equipment could lead to fatigue or result in poor System performance.

10) Install the Bottom Release Cable across the Arm Assemblies.

Verify that the frame is extended as far as it will go. Install the Bottom Release Cable across Arm Assemblies. (see Figure 18). Torque the nuts to 34 Nm (25 ft-lbf) making sure that roughly an equal amount of threads protrude from nuts on both ends of cable. Lock cable in place using remaining fasteners as "jam" nuts.

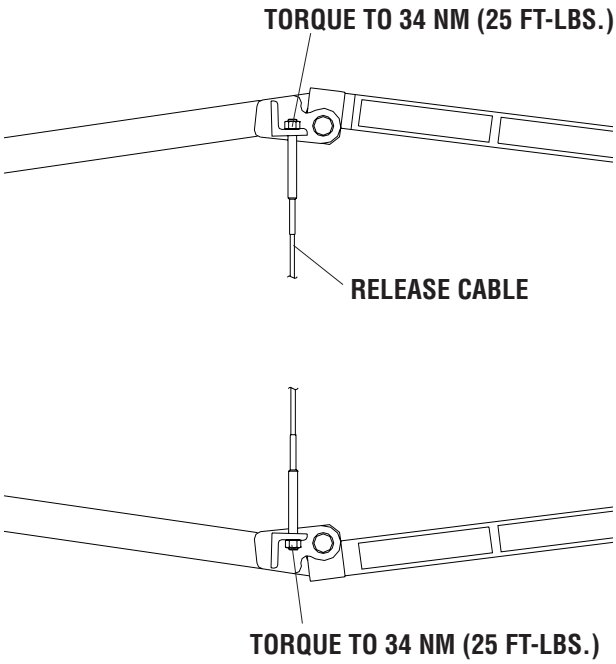


Figure 18

11) Install Cartridges

Remove one end of each alignment cable from the TMA and set aside to clear the top side of each bay. Using a forklift and sling, place Cartridge B in position and secure it using the flat washers, lock washers and nuts provided. Torque the nuts to 120 ± 7 Nm [90 ± 5ft-lbs.] Repeat procedure for Cartridge A (see Figure 19).

12) Install the Top Release Cables across the Arm Assemblies

Install the top release cable across the arm assemblies (see Figure 18). Torque the nuts to 34 Nm (25 ft-lbf), making sure that roughly an equal amount of threads protrude from nuts on both ends of cable. Lock cable in place using the remaining fasteners as "jam" nuts.

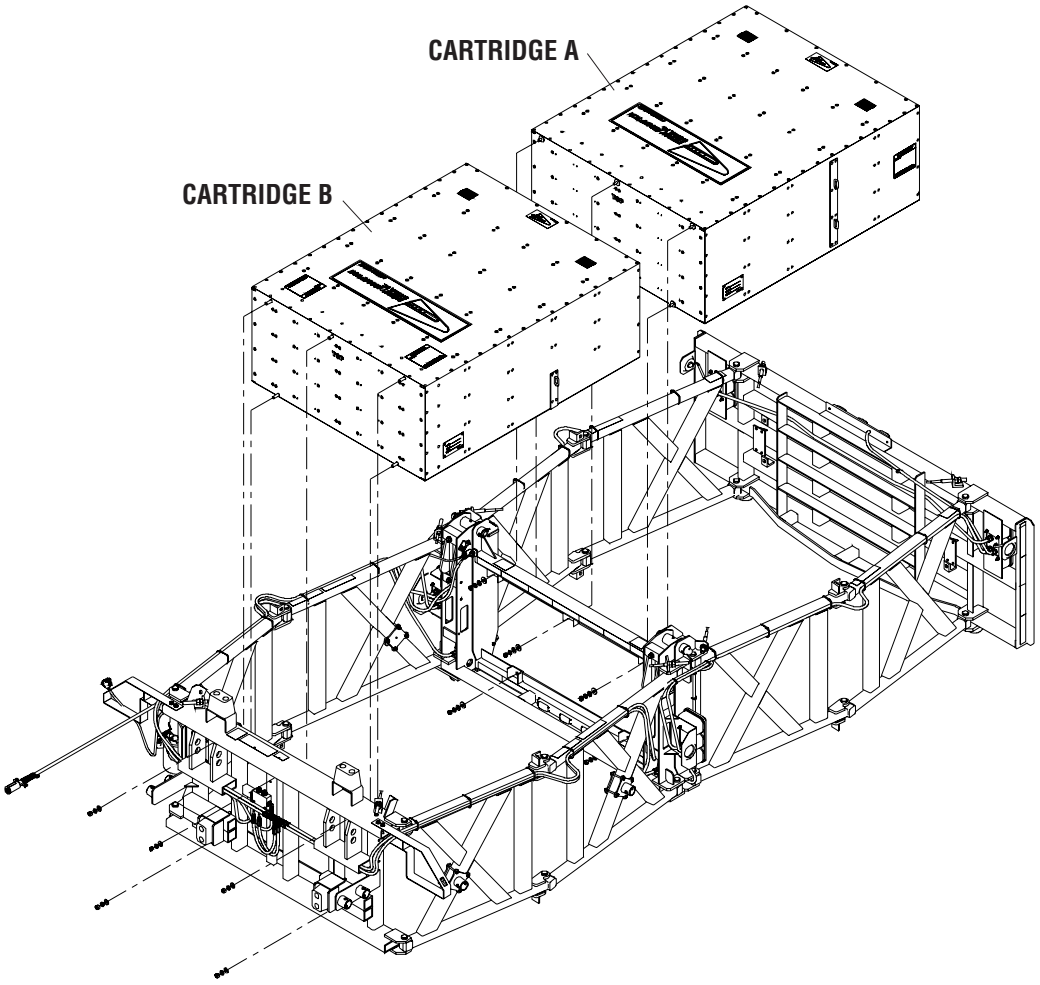


Figure 19

Installation Instructions (cont'd.)

13) Install and Adjust the Alignment Cables

There are four alignment cables (two for each bay). Attach the alignment cables as shown in Figure 20. Measure the diagonals of each bay and adjust the cables so that the diagonal measurements in each bay are the same within the given tolerance (A = B ± 5 mm [3/16"], C = D ± 5 mm [3/16"]) and taught. Cables are "taut" when they deflect 38 mm - 50mm [1 1/2" - 2"] when pressed by hand at the midpoint. Lock each cable in place using the second nut as a "jam nut".

14) Install and Tension the Cartridge Support Cables

There are six cartridge support cables. Install the cables as shown in Figure 21.

Attach thimble end of all cartridge support cables to the intermediate frame using the provided shackles. Pass the stud end of the cable through the corresponding cartridge chain loop, and attach as shown in Figure 21 using a die spring, washer and nuts.

To properly tension the cartridge support cables, tighten the first nut on one cable until all slack is removed, then tighten it until the tensioning springs have been compressed to 32 mm [1 ¼"] in height. Lock this nut in place with the second "jam" nut. Repeat this procedure with the other cables.

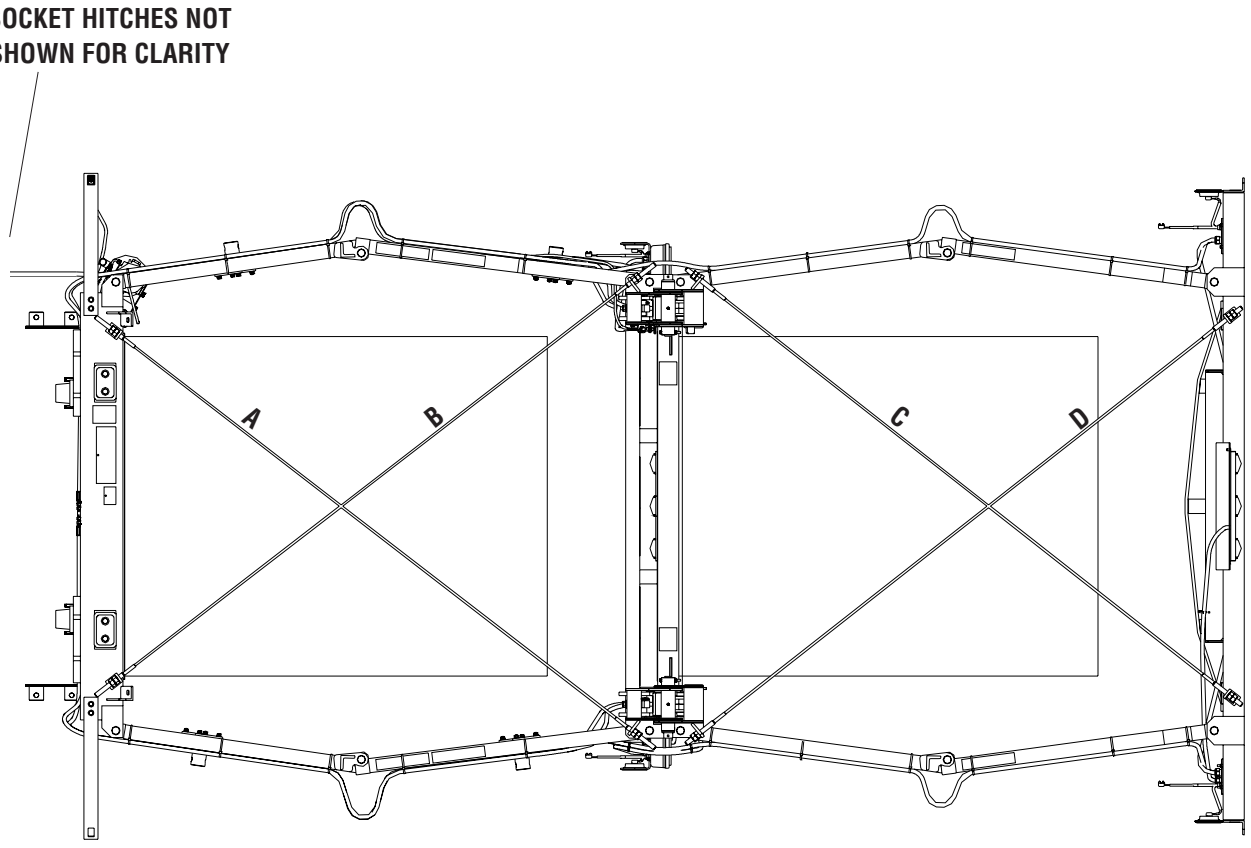
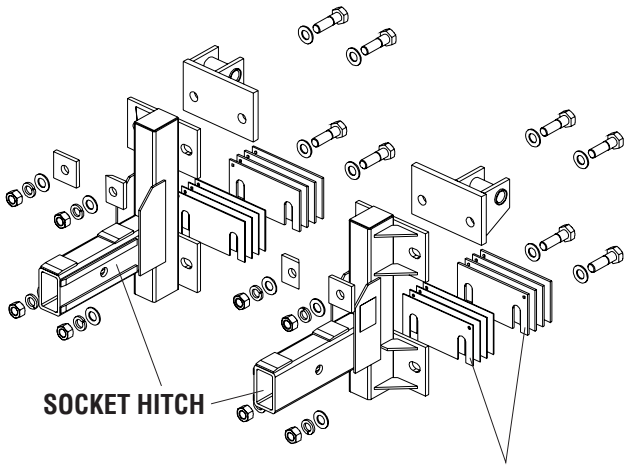


Figure 20

15) Install Side Guides

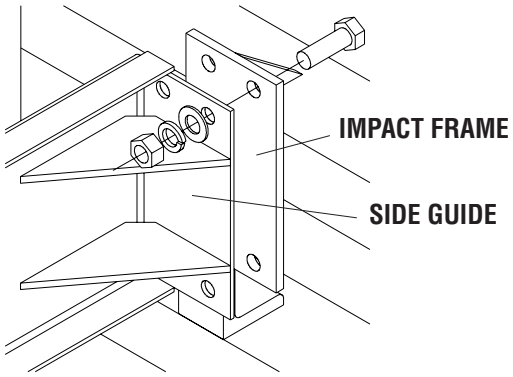
There are four side guides, two for bay 1 and two for bay 2. Attach guides as shown in Detail 21b and tighten bolts.



Detail 21a

16) Adjust the Height and Levelness of the System Frame

Verify that the system frame is 305 ± 25 mm [12" ± 1"] from the ground at the front and rear of the system. It may be necessary to add shims to the socket hitch in order to adjust the levelness of the cartridge. See Figures 21 & 21a.



Detail 21b

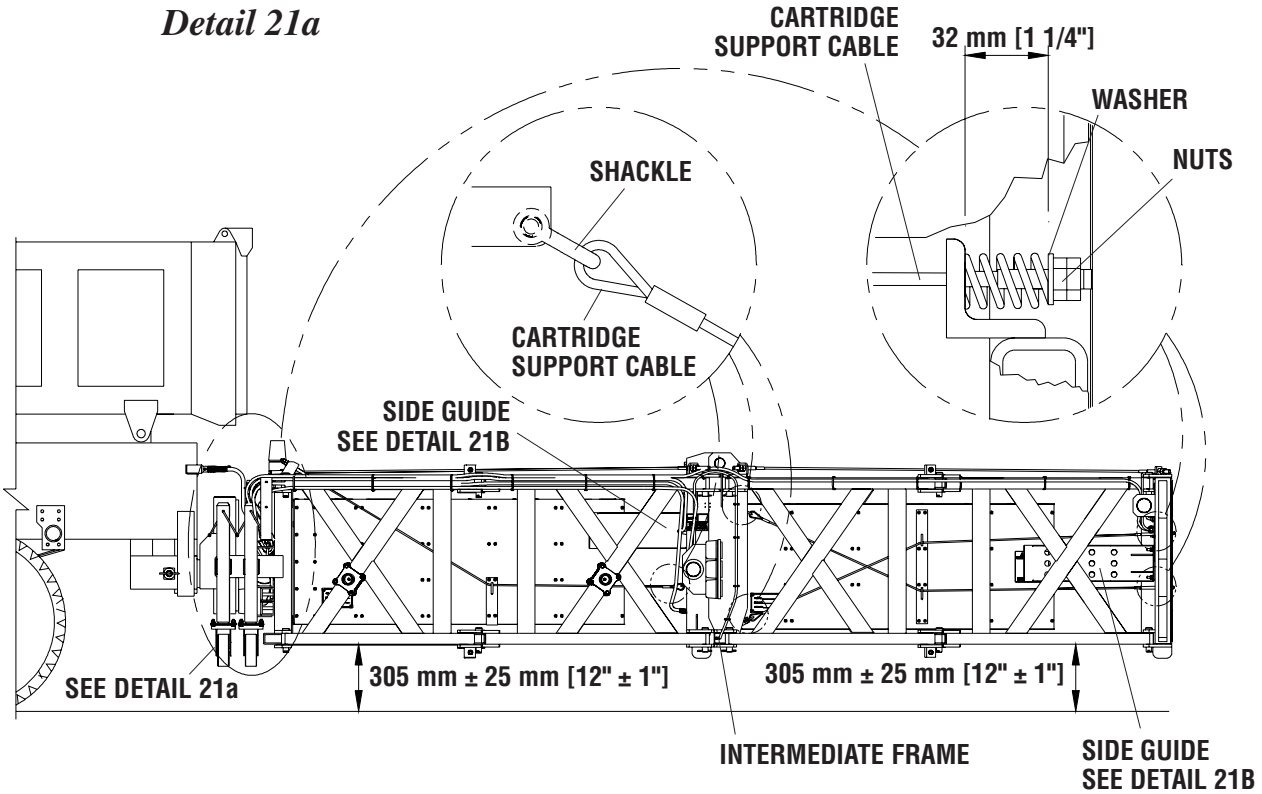


Figure 21

Installation Instructions (cont'd.)

17) Connect the Lights and Controls

Locate the female TMA socket connector in a convenient location on the truck. Make sure that the electrical cord on the TMA can reach this location.

For support vehicles with combined tail and clearance lights, connect a jumper between pins 2 and 6 on the backside of the male TMA plug connector (see VIEW A-A, Figure 22.) Connect the 7-pin plug to the socket on the truck.

The Truck battery must be of the proper voltage. The Safe-Stop 180 TMA is available in 12 volt and 24 volt systems. Be sure the system and truck are compatible. Be sure to use standard safety practices when attaching the battery cables (e.g. do not let the ends of the cables touch, etc.) Do not run the battery cables around sharp corners or metal work, or in other areas that would pinch or cut the cables. Connect the battery cable to the pump motor (see the hydraulic assembly in drawing package).

The controls at the rear of the truck should be mounted to the support frame, on the non-traffic side (side closest to the curb). If they are not, move the rocker switch to the other side by compressing the four tabs on the back side of the switch towards the switch body. Securely fasten cable ties to secure any loose wiring to the TMA frame. Mount the cab switch box inside the cab within easy reach of the driver, and plug in the cab switch box at the mating connector on the TMA.

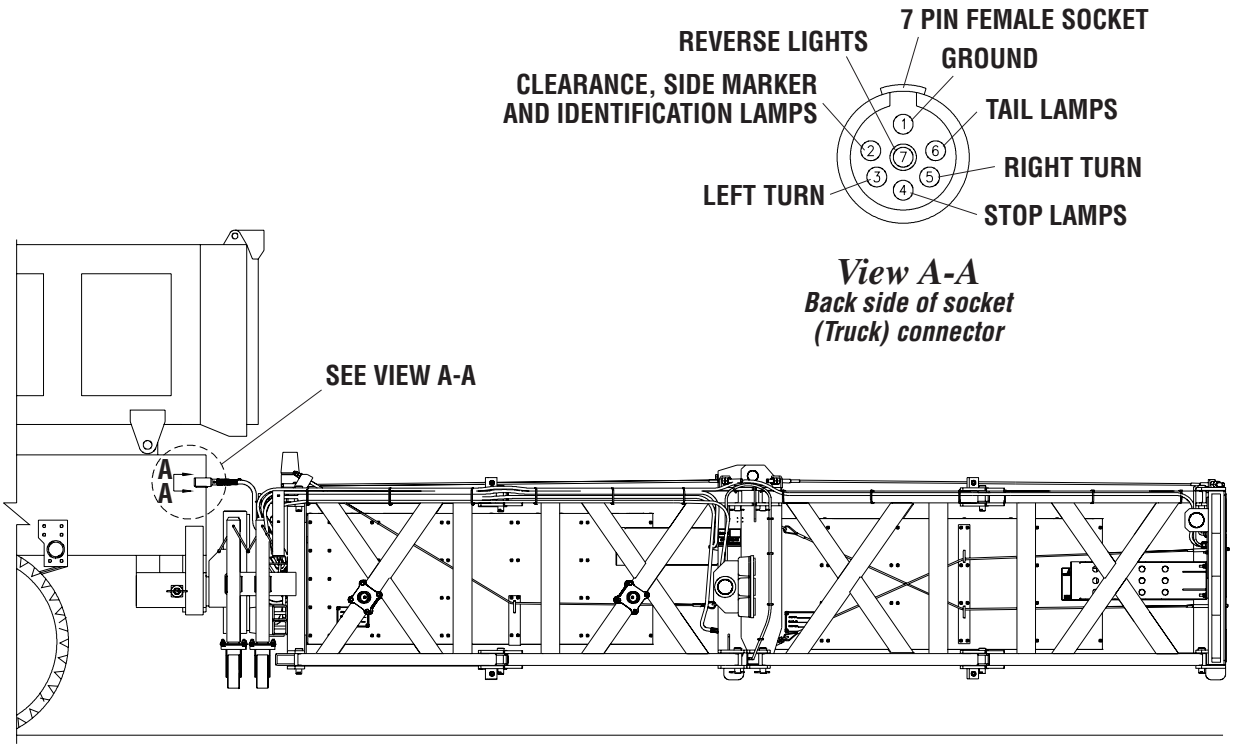


Figure 22

18) Check the Hydraulic System

The hydraulic system is pre-assembled and tested for operation and leaks before shipping. The pump is wired as shown on the hydraulic assembly drawing. Before operating the system, remove the vent plug from the fill port of the hydraulic reservoir and check to see if the reservoir is full. With the TMA unfolded, the fluid should be just visible. Add only Dexron® III fluid if it is not. Do not overfill. Replace the vent plug in the filler port (Be careful not to cross thread it.)

Read Operation Instructions (see page 21: Folding and Unfolding the System). Making sure all electrical and hydraulic lines will not be damaged, use the switch at the rear of the truck to fold and unfold the system twice. This purges air from the system and verifies operation.

Also, cycle the system using the cab switches to verify proper operation.

Note: Continuous operation may run down truck battery.

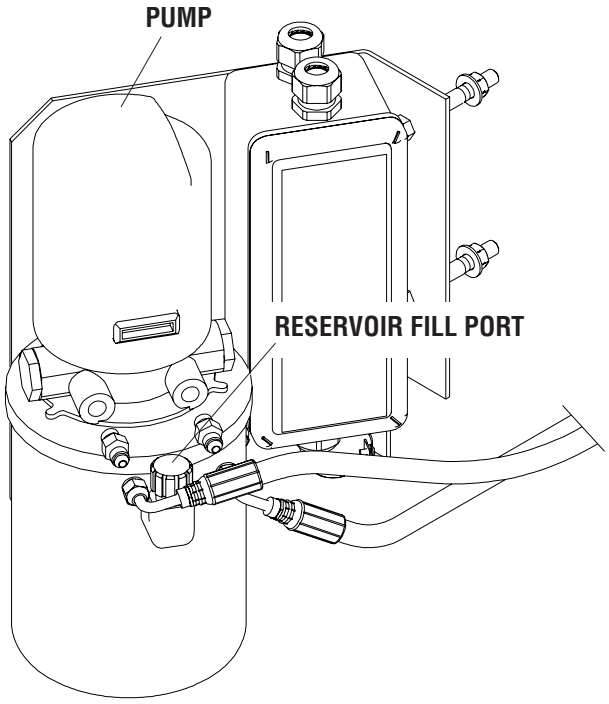


Figure 23

Installation Instructions (cont'd.)

Note: The TMA can only be supported on jacks when completely folded.

19) Store the Jacks

The jacks are provided to facilitate the attachment and removal of a folded Safe-Stop 180 TMA from the truck. Retrieve jacks set aside earlier and place them in the storage positions as shown in Figure 24.

20) Check System Lights For Proper Operation

Verify that all the turn / stop / tail / reverse lights are working properly. Replace any bulbs that are out.

There are two light circuits on the TMA. Verify both circuits are operational.

Raise the system to the folded position and verify secondary lights are working.

With the system unfolded, lights on the impact face will be on and lights on the midframe will be off.

With the system folded, the lights on the midframe will be on and the lights on the impact face will be off.

21) Verify the Position of the Hydraulic / Electrical Lines.

Check the location of all the hydraulic and electrical lines to be sure they will not be damaged during folding and unfolding of the system.

22) Final Check of System

Check the tightness of all of the fasteners. Double check the height and levelness of the system.

23) Ready to Use

The Safe-Stop 180 TMA is now ready for use. To ensure proper and safe operation, all TMA users should be given operating and safety training, as given in this manual and as specified by the owner and local regulations.

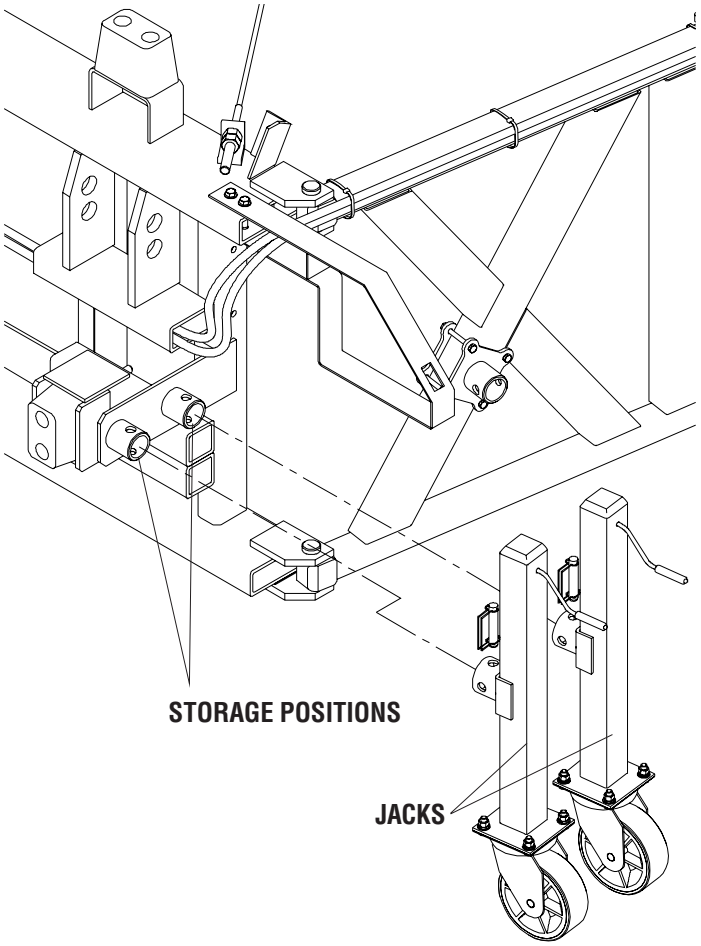


Figure 24

WARNING!
Jacks are to be removed from Arm Assemblies and stored when TMA is in service.

Operation Instructions

Before operating the Safe-Stop 180 TMA, thoroughly read and understand these instructions and the safety section of this manual. Verify that the system is properly installed and in working order. For proper impact performance, the TMA must be equipped with one Safe-Stop 180 Type A Cartridge and one Safe-Stop 180 Type B Cartridge, in their proper positions as shown in Figure 19 on page 15.

The Safe-Stop 180 TMA has been equipped with a hydraulic pump that can be used to fold the TMA from its extended position. The controls are located on one side of the support frame. A set of controls is also located in the truck cab. The controls on the support frame should be mounted to the non-traffic side of the system. To change the mounting, see "Connect the Lights and Controls" section in the Installation Instructions.

While folding or unfolding the Safe-Stop 180 TMA from outside the cab, the operator must stand on the non-traffic side of the truck. Always stay clear of moving parts.

Folding and Unfolding the System

CAUTION: Make sure the area above and behind the system is clear of all objects before proceeding. Under no circumstances should anyone be allowed behind the system when it is being folded or unfolded. When operating from the cab, always be aware of objects behind and above the Safe-Stop 180 TMA.

Folding and unfolding the system: The rocker switch operates by pushing and holding the switch down on the end towards the desired direction (unfold or fold).

The system will not serve its intended purpose when folded. The TMA must be unfolded during shadow or barrier vehicle operations. The truck and Safe-Stop 180 TMA combination offers the best driving characteristics when folded. Driving with the system in the folded position is permissible and recommended during restricted city driving and extended high-speed travel. Be sure to unfold the system either before, or as soon as possible after, entering into a site. Remember that it is recommended that the support vehicle be stopped for TMA folding and unfolding.

The Safe-Stop 180 TMA should only be operated while the truck is at rest. Jarring or severe bumping of the system while folding or unfolding may cause damage to the system or injury to the operator.

The pump is not intended for continuous operation. The pumps motor has a thermal cut-out switch to protect the motor from overheating. The thermal cut-out switch will reset when the temperature of the electric motor has cooled down.

Limitations and Warnings

The SafeStop 180 TMA (Truck Mounted Attenuator) has been tested and evaluated per the recommendations of the National Cooperative Highway Research Program (NCHRP) Report 350*. The SafeStop 180 TMA is capable of decelerating and stopping small cars and light trucks of 820 and 2000 kg [1808 and 4410 lbs.] when the rear of the system is impacted at 100 km/h [62 mph]. In the unfolded position, the SafeStop 180 passed test #50, 51, 52 and 53 at Test Level 3 (100 km/h). Tests 50 (small car) and 51 (light truck) are straight on impacts, test 52 (light truck) is an offset impact and test 53 (light truck) is an angle impact. In the folded position, the Safe-Stop 180 passed test #51 at Test Level 2 (70 km/h).

To achieve optimum impact performance, the Safe-Stop 180 TMA must be mounted to a truck with a traveling weight between 7300 kg and 9000 kg [16,090 and 19,845 lbs.]. The system must be level and the bottom of the system must be 305 ± 25 mm [12" +/- 1"] above the ground.

Impacts that exceed the design capabilities described in this manual (vehicle weight, speed and impact angle) may not result in acceptable crash performance as described in NCHRP 350, relative to structural adequacy, occupant risk and vehicle trajectory factors.

* copy may be obtained from:

Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

It is also available at:
http://safety.fhwa.dot.gov/programs roadside_hardware.htm

*The Safe-Stop 180 TMA shall be employed in the unfolded position: At **all times** while operating as either a **Barrier Vehicle** or **Shadow Vehicle**.

The Safe-Stop 180 TMA should be in the **"unfolded"** position when: Transporting short distances at a low speed, Transporting at a speed much lower that adjacent traffic, and Transporting in areas where vehicle ride characteristics and maneuverability are maintainable.

The Safe-Stop 180 TMA should be in the **"folded"** position when: Transporting long distances at a high speed, Transporting at a speed near the speed of adjacent traffic, and Transporting under conditions of compromised maneuverability typically when the large turning radius clearance needed for the extended TMA is not safe.

Maintenance

Before performing any Maintenance on the Safe-Stop 180 TMA, thoroughly read and understand the Maintenance Section and the Safety Section of this manual.

I. Routine Maintenance

Description	Interval
1. Height and Levelness - The height and levelness of the system is important to its impact performance. Check regularly and adjust as necessary: See Figure 25.	A/R*

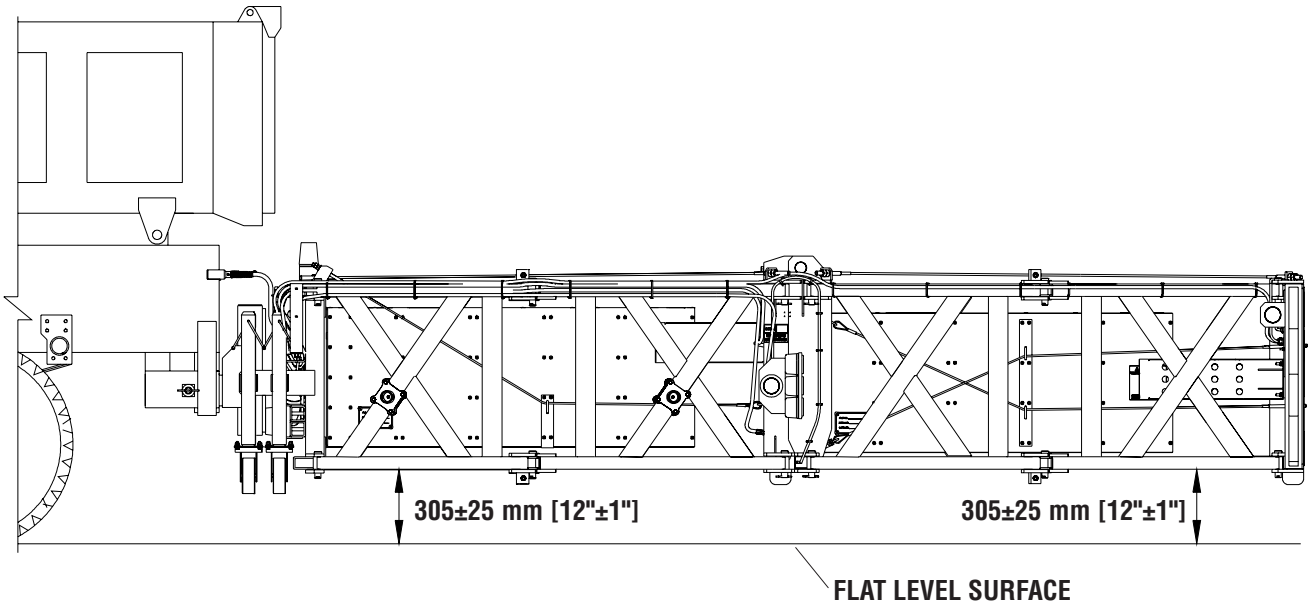


Figure 25

2. Fasteners - Check the tightness of the fasteners monthly. See the drawings for the locations of the fasteners. Be sure to check bolts attaching the cartridges to the support structure. Lock washers should be fully compressed.	1 month
3. Cables - (System unfolded)	
A. Cartridge Support Cables - The spring length should be 34mm (1 1/4"). (Ref Pg 17 - Fig. 21)	1st day, 1st week, then 1 month
B. Alignment Cables - Crossing cables are of equal length +/- 5mm (3/16") and deflect 38-50mm (1 1/2-2"). (Ref. Pg 16)	
C. Release Cables - Torqued to 34 Nm (25ft-lbs). Ref. Pg 14)	1 month
4. Jacks - Check the condition of the wheels on the jacks monthly or as required.	A/R*
5. Lights - Replace the lights as required.	

*A/R = as required

Maintenance (cont'd.)

Description	Interval
6. Pins - Check all pins. Prior to each use, check all pins to make sure they are held in position by a retaining pin as required.	Each use
7. Lubrication - Lubricate as described in the Lubrication Section (Maintenance Section - III) of this manual.	Varies - see Section III
8. Hydraulic Pump - Clean the hydraulic pump as required. Check fluid level and electrical connections monthly. Remove all residue or debris on or around the pump.	1 month
9. Hydraulic Ram - Clean the hydraulic ram as required. Check monthly. Remove all residue or debris on or around the ram.	1 month
10. Hydraulic Hoses - Check all hydraulic hoses for damage, leaks or cracks. Replace damaged or leaking hoses.	Each use
11. Clean System - Clean the frame assembly, cartridges and support structure and impact face from dirt and salt as required. Check monthly. The system can be cleaned with mild soap solution. Always check lubrication after cleaning.	1 month

II. Detaching and Attaching the System to the Truck

1) Detaching the System from the truck

Be sure the TMA and the truck are on level ground.

A. Raise the system to the folded position.

B. Remove the jacks from the storage location and install them on the active mounts as shown in Figures 26 and 27.

C. Extend the jacks until the weight of the system is supported.

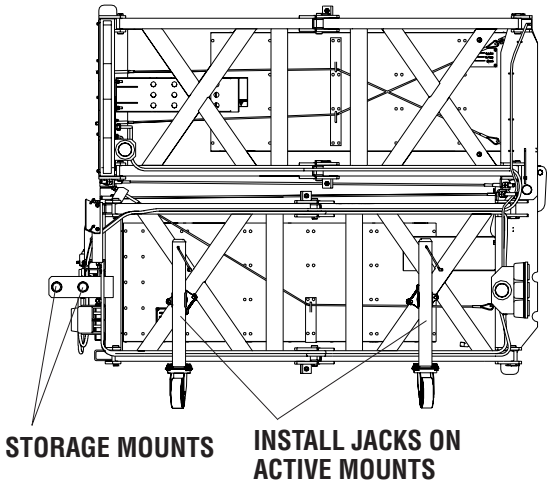
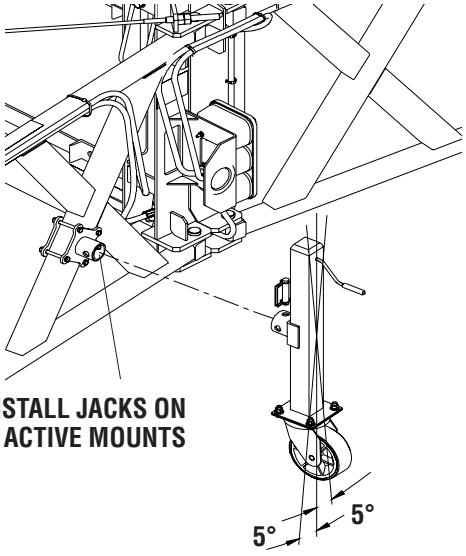


Figure 26

D. Unplug the light harness and disconnect the positive and negative cables from the pump. Unplug the cab switch box at the mating connector on the TMA.

E. Remove the socket hitches from the underride socket receivers by removing 1 x 6 ¼" hitch pins and retainer pins.* See Figure 28. (If the alignment is off, making removal difficult, it may be necessary to adjust jacks or temporarily unmount the TMA from the socket hitches. This can be done by removing the two 1 ¼ x 7 " hitch pins and retainer pins as shown in Figure 29.) Loosen the hardware to ease interference. Be sure to retighten.

F. Move the TMA away from the truck.



TILTING OF THE JACK AT THE ANGLES OF ±5 DEGREES FROM VERTICAL IS NORMAL AND IS DUE TO THE TOLERANCE IN THE ATTACHMENT PIN TO ENSURE EASE OF INSTALLATION AND REMOVAL.

Figure 27

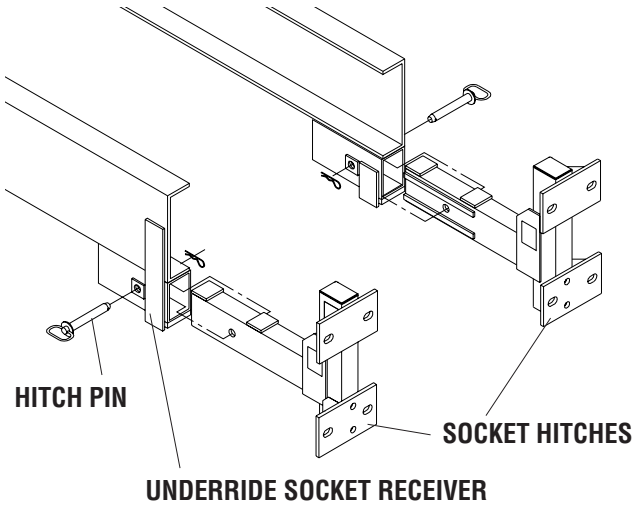


Figure 28

Maintenance (cont'd.)

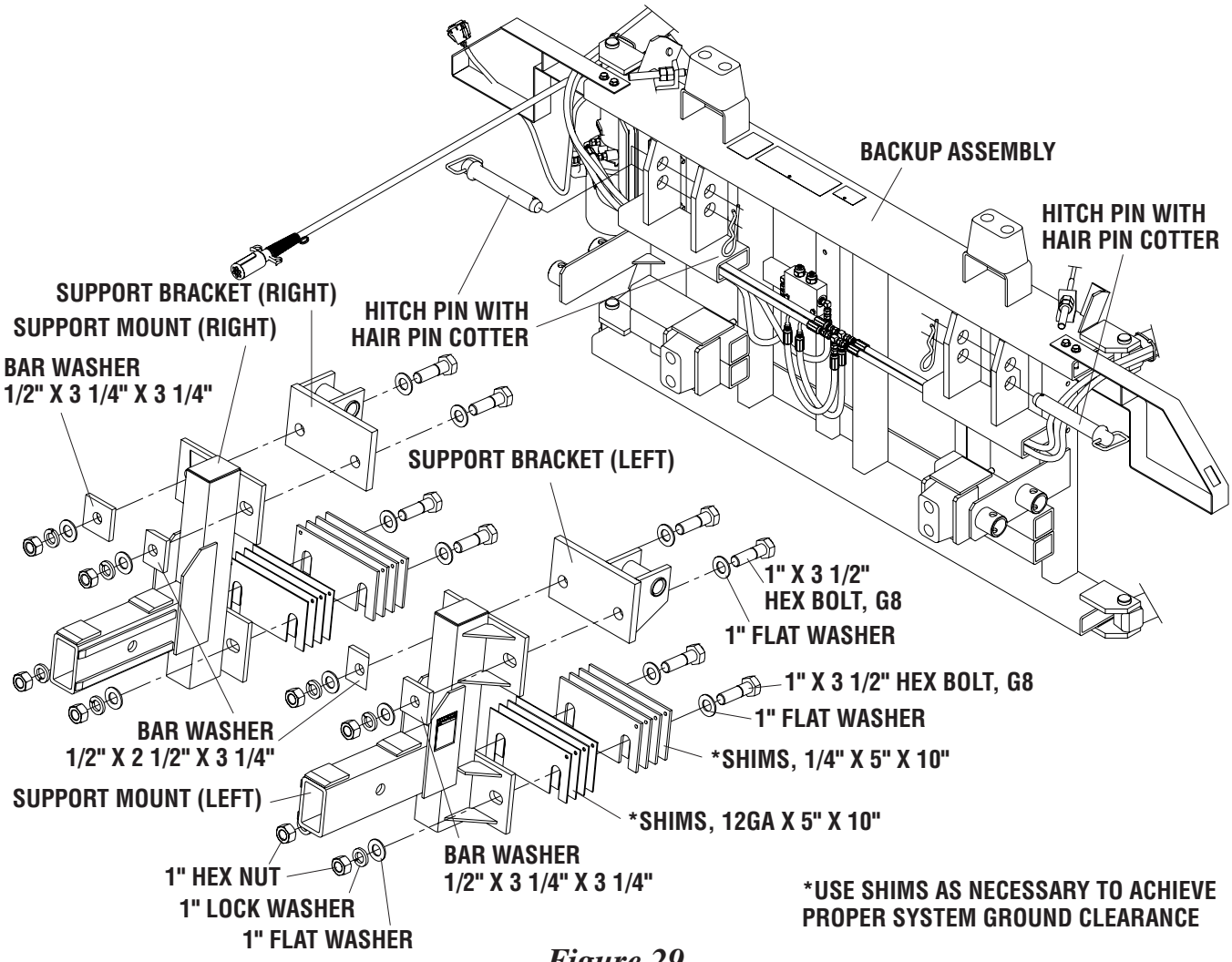

BACKUP ASSEMBLY
HITCH PIN WITH HAIR PIN COTTER
SUPPORT BRACKET (RIGHT)
SUPPORT MOUNT (RIGHT)
HITCH PIN WITH HAIR PIN COTTER
BAR WASHER 1/2" X 3 1/4" X 3 1/4"
SUPPORT BRACKET (LEFT)
1" X 3 1/2" HEX BOLT, G8
1" FLAT WASHER
1" X 3 1/2" HEX BOLT, G8
1" FLAT WASHER
*SHIMS, 1/4" X 5" X 10"
BAR WASHER 1/2" X 2 1/2" X 3 1/4"
SUPPORT MOUNT (LEFT)
*SHIMS, 12GA X 5" X 10"
BAR WASHER 1/2" X 3 1/4" X 3 1/4"
1" HEX NUT
1" LOCK WASHER
1" FLAT WASHER
*USE SHIMS AS NECESSARY TO ACHIEVE PROPER SYSTEM GROUND CLEARANCE

Figure 29

2) Attaching the System to the Truck

A. Move the TMA to truck.

B. Install the socket hitches into the underride socket receivers and pin them into place using 1 X 6 ¼" pin and retainer pin. If alignment is off, making the assembly difficult, it may be necessary to adjust jacks or temporarily unmount the socket hitches from the TMA. Be sure the retainer pins are installed correctly and cannot fall out.

C. Plug in the light harness and connect the positive and negative cables to the pump. Plug in the cab switch box at the mating connector on the TMA.

D. Retract the jacks completely and relocate them to the storage location.

E. Check hydraulic/electrical system for proper operation.

F. Verify system is level and 280-330 mm [11" - 13"] above level ground.

III. Lubrication

When handling hydraulic fluid, use appropriate measures to prevent spillage. Clean any spillage immediately.

1) *Add Hydraulic Fluid*

Add hydraulic fluid as required and check the fluid level monthly. The reservoir is full when TMA is **UNFOLDED** AND when the fluid level is just visible inside the fill port. Use only Dexron® III Hydraulic fluid. Figure 30 shows the location of the hydraulic fluid fill port.

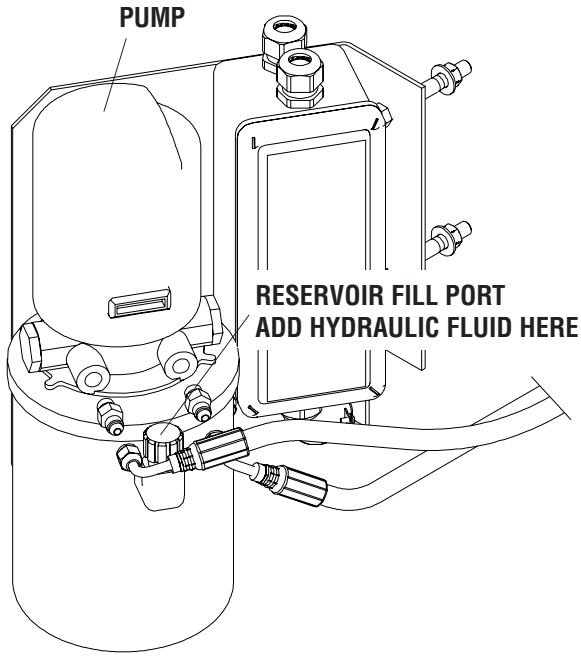


Figure 30

2) *Oil Swivel jacks*

Oil the swivel jacks every six months as shown in Figure 31.

3) *Change Hydraulic Fluid*

Change the hydraulic fluid every 2 years, or if you strongly suspect the oil is contaminated with water. Use Dexron® III fluid only. The empty oil capacity of the reservoir, hoses, and cylinders is approximately 4 quarts (the capacity of the reservoir alone is approximately 2 ½ quarts).

The reservoir and hydraulic system may need to be filled and cycled several times to remove air that may be in the system.

Caution: When refilling an empty system, do not attempt to fold or unfold the system more than 60 degrees until after cavitation has ceased. Always stay clear of a moving TMA.

As the TMA is folded/unfolded, the pump will cavitate when the reservoir is emptied. Add fluid until system will raise to 60 degrees without cavitating. After that, cycle the system beyond 60 degrees and add fluid as necessary. the reservoir should be full (oil just visible at the filler port) when the TMA is fully **UNFOLDED**. If this procedure is not followed, the TMA may come down faster than expected (whether folding or unfolding).

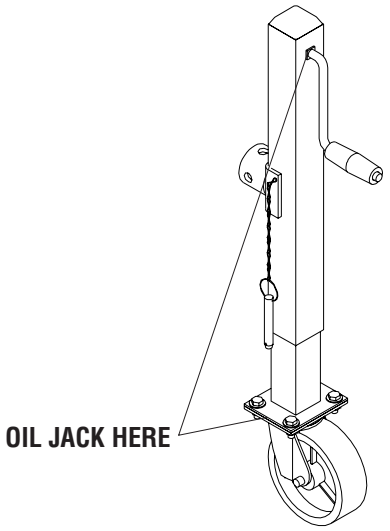


Figure 31

Maintenance (cont'd.)

IV. Technical Specifications

1) Weight

Cartridge A	157 lbs.	71 kg
Cartridge B	185 lbs	84 kg
Frame Components	1672 lbs	758 kg
Jacks	86 lbs	39 kg
Total	2100 lbs	953 kg

2) Dimensions

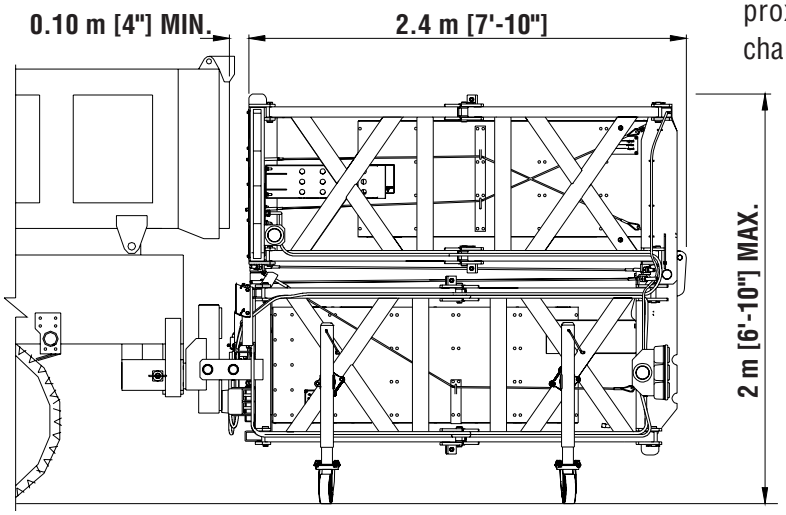


Figure 32

3) Replacement Parts

For details on replacement parts, refer to the drawing package. The drawings include the part numbers and descriptions. For replacement parts, call customer service: 1-(888)-32-ENERG.

4) Operating rates

The system folds to the folded position in approximately 35 to 40 seconds (based on a fully charged battery).

The system unfolds to the unfolded position in approximately 35 to 40 seconds (based on a fully charged battery).

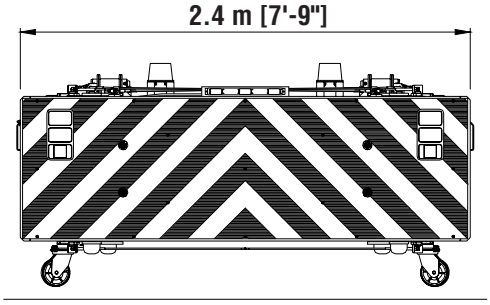


Figure 34

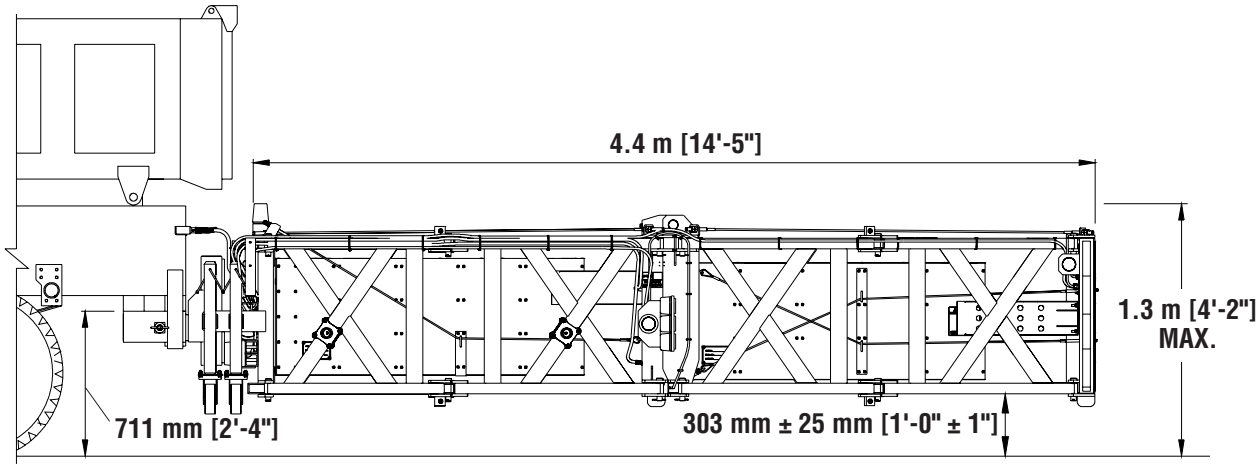


Figure 33

Repair Instructions

I. Post Impact

Note: Only the correct parts manufactured by Energy Absorption Systems, Inc. should be used to repair a damaged system. Failure to comply could result in reduced safety or damage to the system.

1) Inspect the frame for bent parts.

Replace any frame members that have been damaged. Do not attempt to weld or straighten parts. Refer to the system drawings for the part numbers and descriptions of the parts.

2) Inspect pins and bolts for damage.

Replace all bolts and pins that have been damaged. Refer to the system drawings for the part numbers and descriptions of the parts.

3) Expand system and detach one end of each alignment cable.

Caution: Frames may swing side to side.

Extend the frame and detach one end of each of the four alignment cables.

4) Remove cartridges and spent release cables.

Remove the crushed cartridges.

Do not attempt to repair a damaged cartridge. For full impact capacity the cartridges will need to be replaced even if they were only crushed slightly.

WARNING!

For proper System performance, only use Release Cables supplied by Energy Absorption Systems, Inc. Failure to use the correct equipment could lead to fatigue or result in poor System performance.

5) Install the Bottom Release Cable across the Arm Assemblies.

Verify that the frame is extended as far as it will go. Install the Bottom Release Cable across Arm Assemblies. (see Figure 35). Torque the nuts to 34 Nm (25 ft-lbf) making sure that roughly an equal amount of threads protrude from nuts on both ends of cable. Lock cable in place using remaining fasteners as "jam" nuts.

WARNING!

Until the cables are installed, the system may shift to one side.

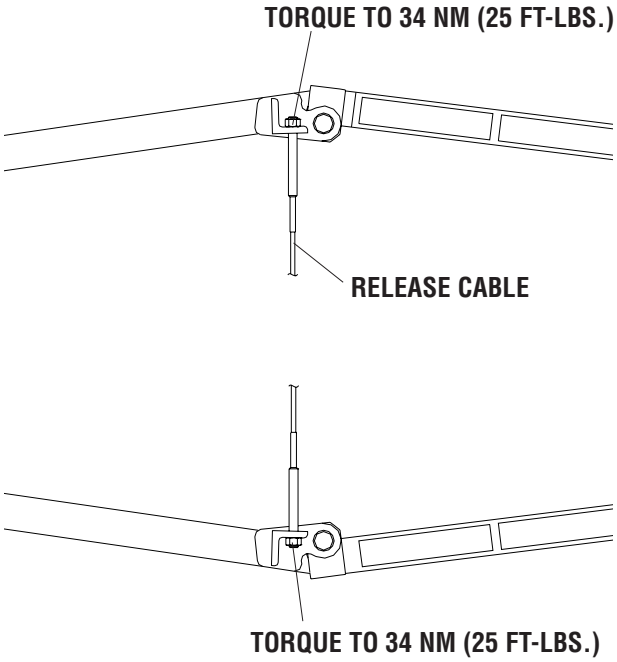


Figure 35

Repair Instructions (cont'd.)

6) Install Cartridges

Remove one end of each alignment cable from the TMA and set aside to clear the top side of each bay. Using a forklift and sling, place Cartridge B in position and secure it using the flat washers, lock washers and nuts provided. Torque the nuts to 120 ± 7 Nm [90 ± 5ft-lbs.] Repeat procedure for Cartridge A (see Figure 36).

7) Install the Top Release Cables across the Arm Assemblies

Install the top release cable across the arm assemblies (see Figure 35). Torque the nuts to 34 Nm (25 ft-lbs), making sure that roughly an equal amount of threads protrude from nuts on both ends of cable. Lock cable in place using remaining fasteners as "jam" nuts.

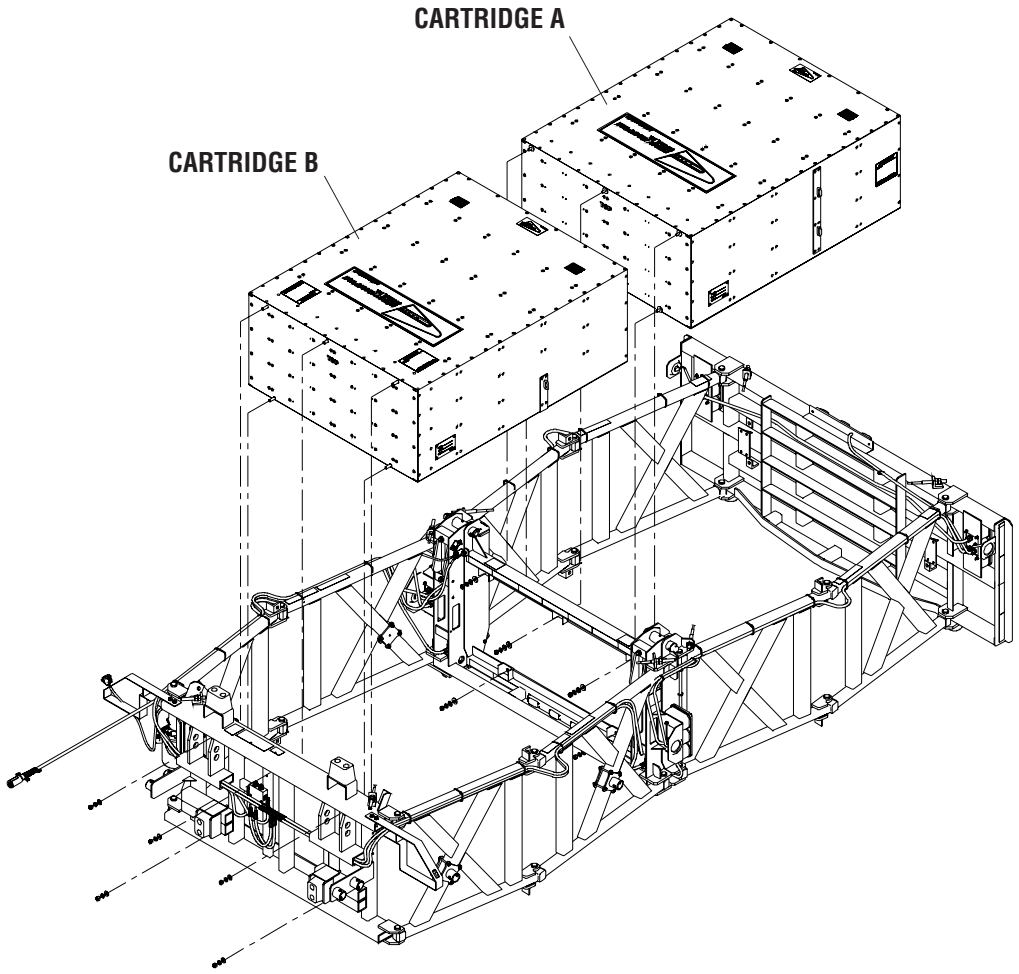


Figure 36

8) Reinstall and Adjust the Alignment Cables

There are four top cables (two for each bay). Reattach the alignment cables as shown in Figure 37. Measure the diagonals of each bay and adjust the cables so that the diagonal measurements in each bay are the same (A = B ± 5 mm [3/16"], C = D ± 5 mm [3/16"]). Lock each cable in place using the second nut as a "jam nut" (see Detail 37).

9) Replace Side-Guides

The Side-Guides must be inspected and replaced if damaged. The Side-Guides are sacrificial and can be easily attached to their respective mounts. Side-Guides are necessary for proper System alignment during an impact and must be in place to ensure proper performance characteristics during System operation in an impact.

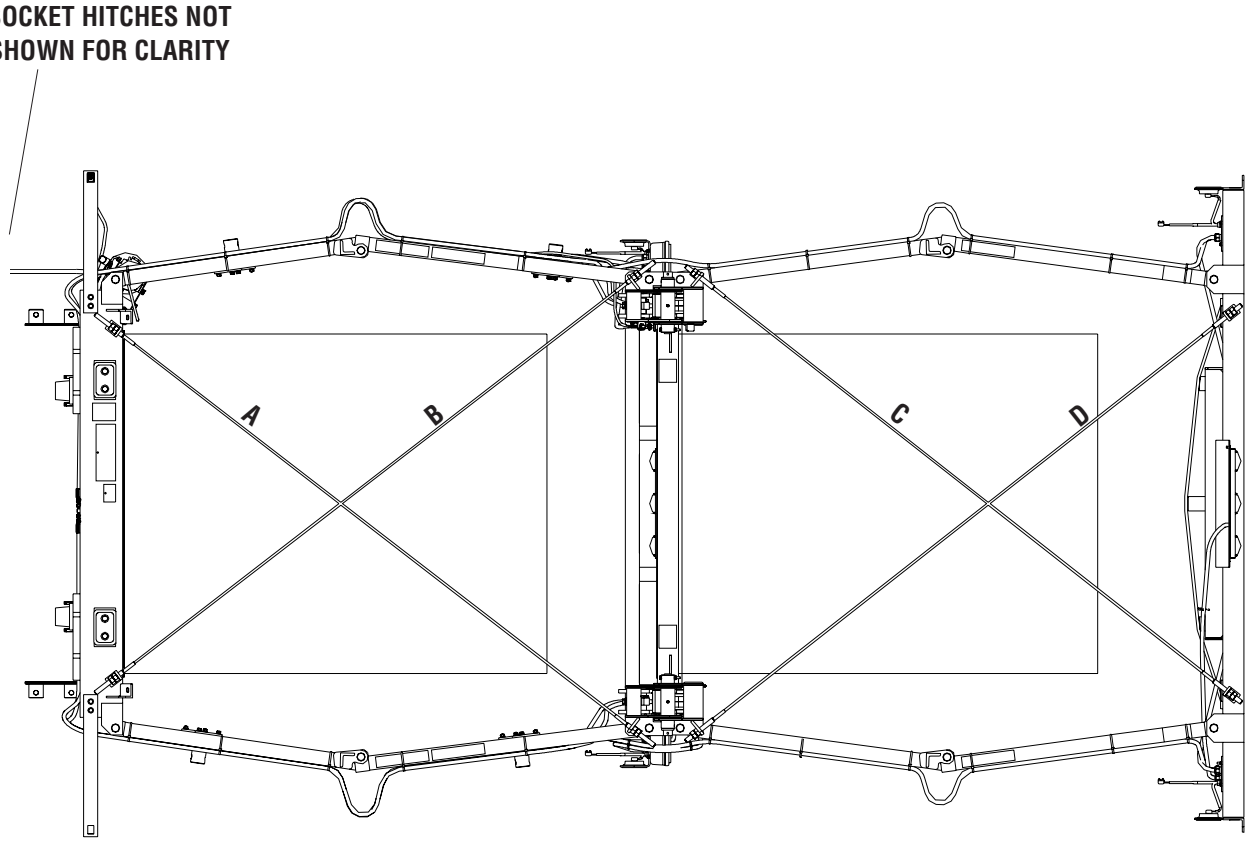


Figure 37

Repair Instructions (cont'd.)

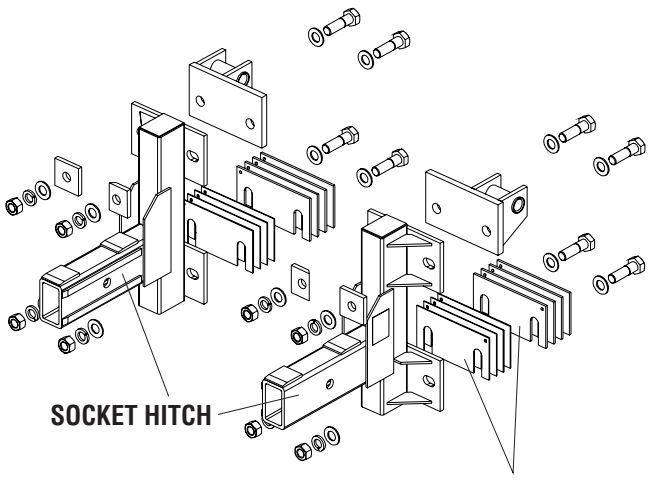
9) Install and Tension the Cartridge Support Cables

There are six cartridge support cables. Pass the stud end of the cable through the corresponding cartridge chain loop, and attach as shown in Figure 38 using a die spring, washer, and nuts.

To properly tension the cartridge support cables, tighten the first nut on one cable until all slack is removed, then tighten it until the tensioning springs have been compressed to 32 mm [1 ¼"] in height. Lock this nut in place with the second "jam" nut. Repeat this procedure with the other cables.

10) Adjust the Height and Levelness of the System Frame

Verify that the system frame is 305 ± 25 mm [12" ± 1"] from the ground at the front and rear of the system. It may be necessary to add shims to the socket hitches in order to adjust the levelness of the cartridge. See Figure 38a.



Detail 38a

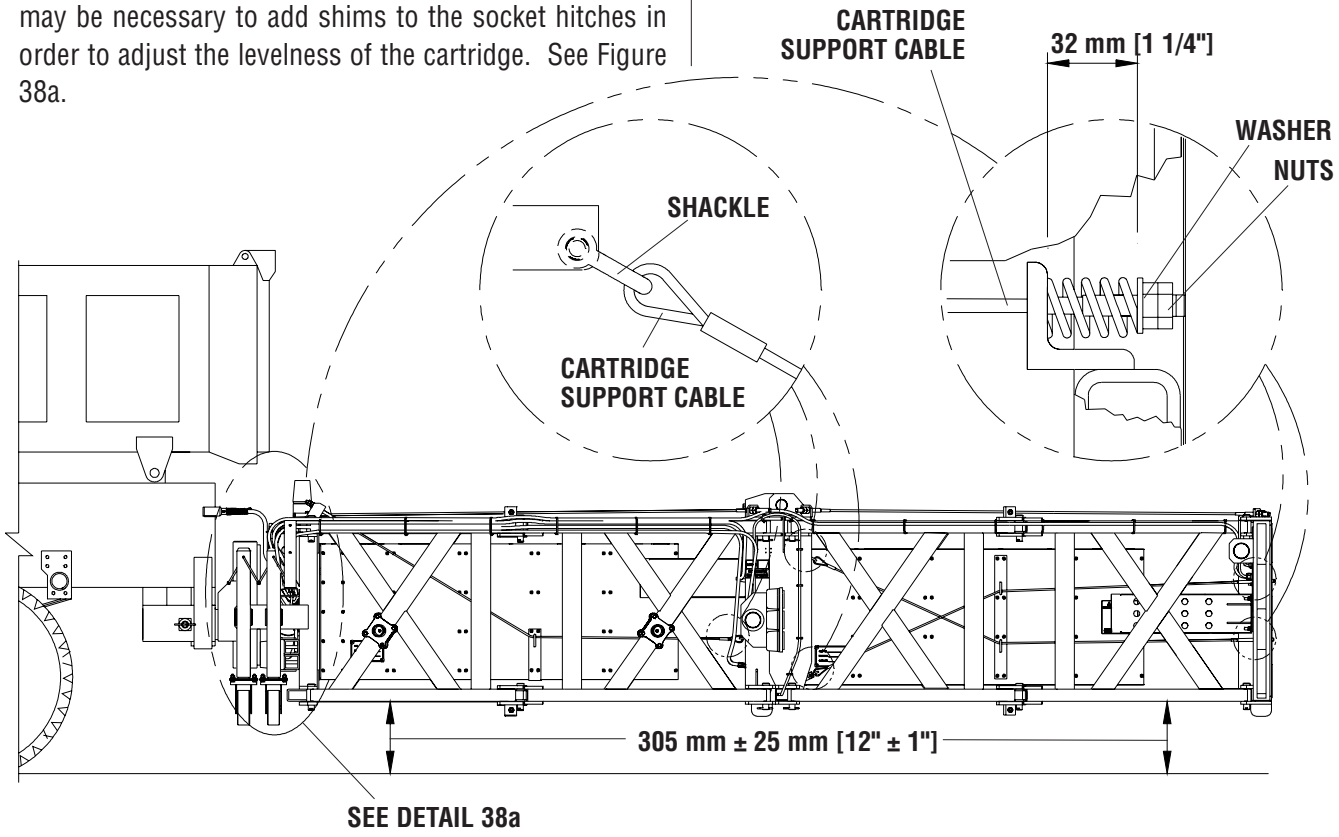


Figure 38

11) Verify Position of Hydraulic / Electrical Lines

Check the location of all the hydraulic and electrical lines to make sure they will not be damaged during the folding and unfolding of the system.

12) Check System Lights For Proper Operation

Verify that all the turn / stop / tail / reverse lights are working properly. Replace any bulbs that are out.

There are two light circuits on the TMA. Verify both circuits are operational.

Raise the system to folded position and verify secondary lights are working.

With the system unfolded, lights on the impact face will be on and lights on the midframe will be off.

With the system folded, the lights on the midframe will be on and the lights on the impact face will be off.

14) Final check

Check the tightness of all the fasteners. Check all steel cables to verify that they are properly attached and tightened.

15) Ready to Use

The system is now ready for use.

Troubleshooting Guide

Safety Notes

1) Always wear eye protection when working on or around machinery or power tools, and while working with hydraulics.

2) Do not attempt to control a hydraulic leak with your hand. High-pressure hydraulic fluid can puncture the skin and cause severe injury or death. Use extreme caution when working on hydraulic systems.

In general, consult Energy Absorption Systems' Customer Service Department if problems associated with operating or repairing the TMA should arise. This guide is meant to be an aide for performing minor repairs, not a detailed repair manual. NOTE: For any problems not listed here, contact Energy Absorption Systems.

Test Equipment

The following is a recommended list of test equipment required to troubleshoot D.C. powered hydraulic systems.

1. PRESSURE GAGE

A 34450 kPa [5000 psi] pressure gage, preferably glycerin filled, is a valuable and relatively inexpensive tool for checking pressure in the various sections of the circuit.

2. D.C. TEST LIGHT

A test light is a light bulb with one lead wired to an alligator clip and the other lead connected to a metal probe. It is used to check for the presence of a voltage in the electrical circuit. With the alligator clip grounded, the light glows when the probe comes into contact with a hot electrical component.

3. CONTINUITY LIGHT

A continuity light is like a test light but contains its own battery. It is used for testing electrical circuits when the components are not connected to a power source.

4. VOLT METER

A D.C. voltmeter can be used to troubleshoot voltage problems. Two common uses are: 1) Ground one probe while using the other to probe hot leads in search of the available voltage at the point where the second probe is connected. 2) Measure a voltage drop in a wire or component by connecting one probe to one end and the remaining probe to the other end of the item in question.

5. OHM METER

Note: All tests conducted with an ohmmeter must be done with the power source disconnected from the system.

An ohmmeter is used to measure resistance and is useful when working with solenoid coils. On some coils the wire resistance is large enough that a D.C. test light might not illuminate, falsely indicating an open circuit (infinite resistance). A successful coil test, however, should always show some non-infinite value of resistance.

6. ASSORTED HOSSES, PRESSURE FITTINGS

These can be used to connect and/or isolate certain parts of a hydraulic circuit for diagnosing hydraulic problems.

If you suspect problems, do not operate the system. Diagnose and repair, or contact Energy Absorption Systems' Customer Service Department for assistance.

Hydraulic Fluid

1. PURPOSE

The main purpose of hydraulic fluid is to transfer power from the pump to the actuators. Secondary tasks include reducing metal on metal friction, and preventing the formation of rust and sludge. These traits are achieved when the oil has a good lubricity (slipperiness), and with additives that inhibit oxidation and the entrainment of air and water in the oil, respectively. The viscosity (thickness) of the oil must

be appropriate for the operating temperature to minimize unwanted leakage, and to lubricate the close fitting parts in the system.

Additionally, the oil must be compatible with the seals used in the system. Finally, the oil must be able to pour or flow at the lowest expected operating temperature so that it can enter the reservoir and pump for use. For all of these reasons, automatic transmission fluid (ATF, Dexron®) has been found to be the best readily available fluid for the job in most climate conditions.

2. SELECTING FLUIDS FOR APPLICATIONS OUTSIDE ATF'S OPERATING TEMPERATURE RANGE

NOTE: Consult Energy Absorption Systems' Customer Service Department when considering and before changing hydraulic fluid to assure compatibility with existing components.

When looking for fluids that can be used in place of ATF or for applications where the operating temperature is outside the range of ATF, the following specifics should be discussed with your local oil distributor:

A. Fluid must be compatible with Buna-N sealing compounds.

B. The Pour Point must be below the lowest anticipated temperature that will be encountered.

C. It should contain Rust or Oxidation inhibitors as well as other detergent type inhibitors.

D. The viscosity (SUS) should lie between 80 and 375 in the operating range, with the ideal viscosity near 200 SUS.

E. The viscosity index should be as high as possible. As an example, ATF has the following specs as listed by most oil manufacturers:

[1] Viscosity (SUS)

37 deg. C [100 def. F]	185 to 205
99 deg. C [210 deg. F]	45 to 55
Pour Point	-44 deg. C [-45 deg. F]
	-37 deg. C [-35 deg. F]
Viscosity Index	145 to 165

Note: In a cold weather emergency application only, SAE 10W non-detergent oil can be mixed by volume with no more than 30% #1 fuel oil or kerosene.

Hydraulic System

Finding & Solving Problems

CAUTION: Repair of hydraulic components should only be performed by fully qualified individuals or hydraulic shops. In most cases, the customer should contact Energy Absorption Systems' Customer Service Department for advice on repair or replacement of TMA parts. All replacement components must be approved for use or provided by Energy Absorption Systems to guarantee quality and correctness.

Hydraulic system failures can occur in several ways: A gradual or sudden loss of pressure or flow, a loss of power at the pump, or other difficulties. Any of the system's components could be the cause. Start with the checklist below that most applies to the symptom at hand.

Note: Avoid the use of Teflon tape on hydraulic fittings as it can easily jam valves and cause failures in the hydraulic system.

1. MOTOR DOES NOT START

- Improper ground. Check ground connections.
- Improper or low voltage supply. Check voltave supply from truck power.
- Electrical system inoperative: Verify that cable from battery is correctly attached.
- Failed motor solenoid: Replace, taking note of correct wire locations for reassembly. (Call first)

Troubleshooting Guide (cont'd.)

2. SYSTEM OPERATES ROUGH or ERRATIC

- Insufficient or no oil in system, pump losing prime: Fill system, check for leaks.
- Ground fault: Check for loose wire leads, verify that pump is securely mounted to TMA frame and that the truck lighting plug is correctly attached.
- Wrong oil in system (should be Dexron® II or III): Change oil.
- Clogged or dirty cylinder check valve: Remove the load on cylinders, disassemble cylinder check valve and clean (see section on Cylinder Check Valves).
- Oil line restricted, line dirty or collapsed: Clean or replace oil line.
- Dirty pump: Clean exterior and check for contaminated oil. If necessary, drain, flush, and refill system with approved oil.
- Worn components (valves, cylinders, etc.): Check for cause of wear. Replace worn parts with correct components.
- Leakage: Check all components, verify tightness of fittings, and inspect hoses for wear while system is idle. Replace damaged hoses or fittings.
- Excessive loading (especially any features not originally installed by Energy Absorption Systems): Remove excessive load.

3. SYSTEM OPERATES SLOWLY or CAVITATES

- Low voltage: Verify voltages with D.C. voltmeter and check truck charging system.
- Oil viscosity too high or cold oil: Allow oil to warm up before operating or replace with oil intended for correct operating temperature range.
- Low oil level: Check reservoir and add oil as necessary.
- Air in system: Check for leaks and tighten as necessary. Cycle the system several times to relieve air from system.
- Oil leaks: Tighten fittings, replace seals or damaged lines.
- Worn components (valves, cylinders, etc.): Check for cause of wear. Replace worn parts with correct components.
- Restriction in lines or cylinder check valves: Remove the load on cylinders, clean lines or valves, replace hoses if necessary.

4. SYSTEM OPERATES TOO FAST

- Internal fixed flow controls reversed: Contact Energy Absorption Systems.

5. PUMP OVERHEATS

- Incorrect, low volume, or dirty oil: Add or change oil as necessary.
- Excessive internal leakage (pump): Replace the pump (contact Energy Absorption Systems).
- Restriction in lines or cylinder check valves: Remove the load on cylinders, clean lines or valves, replace hoses if necessary.
- Insufficient heat radiation: Clean dirt and mud from reservoir and components.

6. NOISY PUMP

- Low oil level, incorrect or foamy oil: Replace or add oil as necessary.
- Suction line or inlet screen plugged: Consult Energy Absorption Systems.
- Worn or damaged pump: Replace the pump (contact Energy Absorption Systems).

7. LOAD DROPS WHEN SYSTEM IS LOCKED

- Leaking cylinder seals or fittings: Remove the load on cylinders, inspect for damaged hoses or fittings, tighten fittings or replace hoses if necessary.
- Faulty counter balance valve: Remove the load on cylinders. Clean or replace the appropriate counter balance valve components.

8. LEAKY CYLINDER(S)

- Seals worn or damaged: Replace the cylinder.
- Rod damaged: Replace the cylinder.

Pressure Relief Valve

1. PURPOSE:

A. Limit the maximum pressure in the hydraulic system to a safe level.

B. Keep the motor amperage (and battery drain) at a minimum when the cylinders dead head (reach full stroke).

2. ADJUSTING RELIEF VALVE (on the pump)

Note: In general, do not adjust the relief valve. It is set to the correct operating pressure at the factory.

A. Symptoms of incorrect pressure relief adjustment

1. Relief pressure too high

a. Battery current draw is excessive.

b. Motor RPM is slow.

2. Relief pressure too low.

a. Motor RPM is fast.

b. System will not fold (cylinders will not extend).

c. Excessive turbulence in reservoir.

Note: On applications where a hydraulic component is being replaced, contact Energy Absorption Systems' Customer Service Department to verify component compatibility.

> ***WARNING!***
> Do not exceed pressure rating for hydraulic system components! System pressure is set to 2200 psi at the factory.

Counter Balance Valve

1. PURPOSE

The counter balance valve allows free flow of hydraulic oil into and out of the cylinders, but blocks the flow when there is no pump pressure. The counter balance valve locks the system when the pump is not running.

> ***WARNING!***
> When the system is stopped at an intermediate angle, there will be pressure on the oil in the hoses between the counter balance valve and cylinders! This pressure is supporting the load of the folding bay! ALWAYS make sure the TMA is completely folded or completely unfolded before loosening a hose fitting or servicing any check valve! This will minimize the chance of injury from an uncontrolled falling load, or spray of high-pressure oil.

2. REPAIRING COUNTER BALANCE VALVE

A. Symptoms

If the TMA exhibits a slow drifting of the folding bay when the pump is not running, one of the following may be true:

1. The counter balance valve has become blocked by foreign debris in the oil line.

2. The piston ring seals inside the cylinders have been compromised.

B. Repair procedure

1. Blocked cartridge

a. Again, make sure the system is completely folded or completely unfolded.

b. Remove the cartridges from the valve body, being cautious of oil spray from residual pressure in the system.

Troubleshooting Guide (cont'd.)

c. Clean the cartridge using compressed air, making sure to direct the air away from anyone's face. Avoid breathing the oil mist that this process may create.

d. Reinstall the cartridge as they were before disassembly.

2. Piston ring seal

a. Refer to the following section on Hydraulic Cylinders.

Note: If the cartridge valve has failed in some other way, do not attempt to repair it. Replace it with a new valve by contacting Energy Absorption Systems' Customer Service Department.

Hydraulic Cylinders

Caution: Never allow anyone underneath the moving portion of the Safe-Stop 180 TMA. Block out all loads and disconnect electrical contacts prior to performing any service on hydraulic equipment.

1. TROUBLESHOOTING

If you suspect problems with the hydraulic cylinders on the TMA, you may need to remove the cylinders from the TMA for repair or replacement. The cylinders can only be removed when the TMA is completely folded. Double check that all electrical contacts between the TMA and support vehicle have been disconnected prior to performing any work on the hydraulic system.

A cracked, bent, or leaky cylinder may need repair, but should almost always be replaced to ensure proper, reliable performance.

2. CYLINDER REPLACEMENT

A. Completely fold the TMA.

B. Unplug all electrical connections between the TMA and the support vehicle.

C. See TMA drawing 3526806-0000. Loosen (but do not disconnect) the "Follower Link Pivot" and the "Push Link Pivot" where they are bolted to the "Weldment, Front Intermediate Frame" and the "Weldment, Rear Intermediate Frame", respectively.

D. At the top end of the cylinder rod, loosen the set screw and push out the short 1" diameter pin, making note of the alignment and location of all linkage components for later reassembly.

E. Disconnect the hoses leading into the cylinder at two convenient locations, and place temporary caps on the hoses or cylinder ports to prevent spillage or contamination.

F. At the bottom end of the cylinder body, remove the set screw from the frame and push out the long 1" diameter pin, making note of the alignment and location of all components for later reassembly.

G. The cylinder should now be free. Reinstall a new cylinder in the reverse order of these removal steps, making sure to properly align and (where necessary) tighten all components. Use blue thread locker (medium strength) on all fasteners.

Note: See the section on Hydraulic System Priming. You will likely need to prime the system if you are installing a new or "dry" cylinder.

3. REPAIRING CYLINDERS

Replace any faulty or damaged cylinders with a new cylinder.

Hydraulic System Priming

Safe-Stop® 180 TMA hydraulic systems come direct from the factory primed and ready to operate. Priming should only be necessary after changing the oil or if you have recently repaired a leak.

1. PRIMING PROCESS

Systems that have been disassembled for repair require priming for proper performance. The hydraulic system is said to be primed when all hoses & the cylinders are full of oil, and the air has been expelled. The reservoir should be full of oil (oil just visible at the filler port) when the TMA is UNFOLDED. Prime the pump as follows:

A. Detach the long hoses where they connect to the cylinder. Note which hoses connect to the top and bottom of the cylinder.

B. Jog the pump by briefly depressing the "FOLD" button until clean oil flows from two of the hoses.

C. Repeat this process for the other two hoses by briefly depressing the "UNFOLD" button.

D. Replace and retighten all four hoses.

CAUTION: Do not completely fold or unfold the TMA until it has been jogged a few times to work out any air in the system. Add oil at the filler port any time that the pump begins to cavitate.

E. Jog the system a few times by depressing "FOLD" or "UNFOLD" (depending on the current state of the TMA).

2. CHECK FOR THESE PROBLEMS WHEN A SYSTEM FAILS TO PRIME:

- Correct pump mounting, with the motor on top and reservoir at the bottom. All Safe-Stop 180 TMAs should have vertically mounted pumps. Mounting a pump in some other orientation would prevent the suction line from picking up oil, causing cavitation. NOTE: Vertical mount pumps have a label stating such designation.
- A solid plug in the reservoir filler port instead of a vent plug (see Reservoir section).

Reservoir

Note: Do not use a solid plug or fill cap without a filter/breather element, or damage will be caused to the pump and/or reservoir.

1. USE RECOMMENDED FLUID:

Fill reservoir with Dexron® III or ATF (See Hydraulic Fluid section).

2. PROPER FILLING:

A. With the TMA UNFOLDED (cylinders fully retracted), fill the reservoir so that oil can just be seen in the filler port.

B. Operate the unit several times starting with short cylinder strokes, increasing the length of each successive stroke.

C. Recheck oil level often and add as necessary to keep the pump from picking up air.

D. Reinstall the filter/breather plug provided.

Troubleshooting Guide (cont'd.)

3. RESERVOIR PROBLEMS

A. Clear oil flowing out of the filler port usually means the reservoir was completely filled before the cylinders were fully collapsed (TMA unfolded).

B. Foamy oil flowing out of the filler port points to one of the following:

1. Air present in the system; the response is usually spongy, or the cylinders may move with a jerking motion.

2. There is no drop tube or "down spout" on the return line so that the oil is not returning to the bottom of the reservoir.

C. Water in the oil:

Water can enter the reservoir through the filler port if the unit is left outdoors or washed with a high-pressure washer. Protect the unit, whenever possible, and change the oil if you suspect contamination. In cold weather the water could freeze, preventing the pump from working until the ice melts.

Electrical Problems

WARNING!
REMOVE ALL RINGS, WATCHES, JEWELRY, ETC. PROIOR TO DOING ANY ELECTRICAL WORK!

1. LOW VOLTAGE

Operating D.C. (direct current) power units efficiently requires proper voltage. Any attempt to operate below the minimum required voltage could cause system failure.

A. Signs that point to low voltage are:

1. Motor won't run because solenoid won't shift.

2. Motor running at reduced speed.

B. Minimum voltage requirements:

1. Between the motor stud and ground: 9.0 volts at max. load.

C. Causes for low voltages are:

1. Improper ground. Check grounds.

2. Battery capacity too small.

3. Cable ends not electrically secure to battery cable.

4. Battery cable size too small for load and length of run. Copper #4 automotive battery cable is the recommended min. size. Larger copper battery cable (#2, #1, #0, or #00) may be required for cable lengths over 30 feet to keep performance from deteriorating.

5. The pump ground is established through the battery ground cable. Clean any dirt or rust from cable to achieve proper ground.

6. Burnt contacts on motor solenoid.

D. Check for low voltage as follows (requires a voltmeter):

1. On alternator equipped vehicles, verify that the battery voltage is approximately 13.5 volts with no electrical accessories operating and the engine running.

2. Operate the TMA while an assistant uses the voltmeter to probe each connection, cable end, and cable from the battery all the way back to the motor stud. Note the voltage losses. Make necessary repairs. Increase the voltage above the minimum as required.

Note: Check the ground connections as well; remove any paint, rust, and dirt that may be acting as insulators.

2. D.C. MOTORS

Before concluding that the hydraulic pump is malfunctioning:

- Verify that all connections are secure and that the problem does not lie somewhere else.
- Check ground.
- Check brushes for wear, and replace if necessary.

Note: A motor that does not turn in freezing weather could be caused by frozen water in the oil.

If it has been verified that the pump is defective, contact Energy Absorption Systems' Customer Service Department for assistance.

3. ELECTRICAL SWITCHES

A. If you suspect that a switch is defective, use one of these three methods to test the operation of the switch:

1. First check grounds.
2. Use a continuity light to test the switch (see Test Equipment section).
3. Use a circuit test light to test the switch (see Test Equipment section).

B. Motor solenoid switches:

The solenoid switches found on the hydraulic pump are four post style solenoid. They should be constructed and wired such that:

1. The large posts with the connecting bar must be attached to the cable from the battery.
2. The same post (shared hot lead) provides power to the control circuit.
3. The remaining large posts attach to the motor wires.
4. The small post on each solenoid connects to the control circuit on one side and the other small post connects to ground. This circuit activates the solenoid (and hence the pump) when energized.

4. ELECTRICAL POLARITY

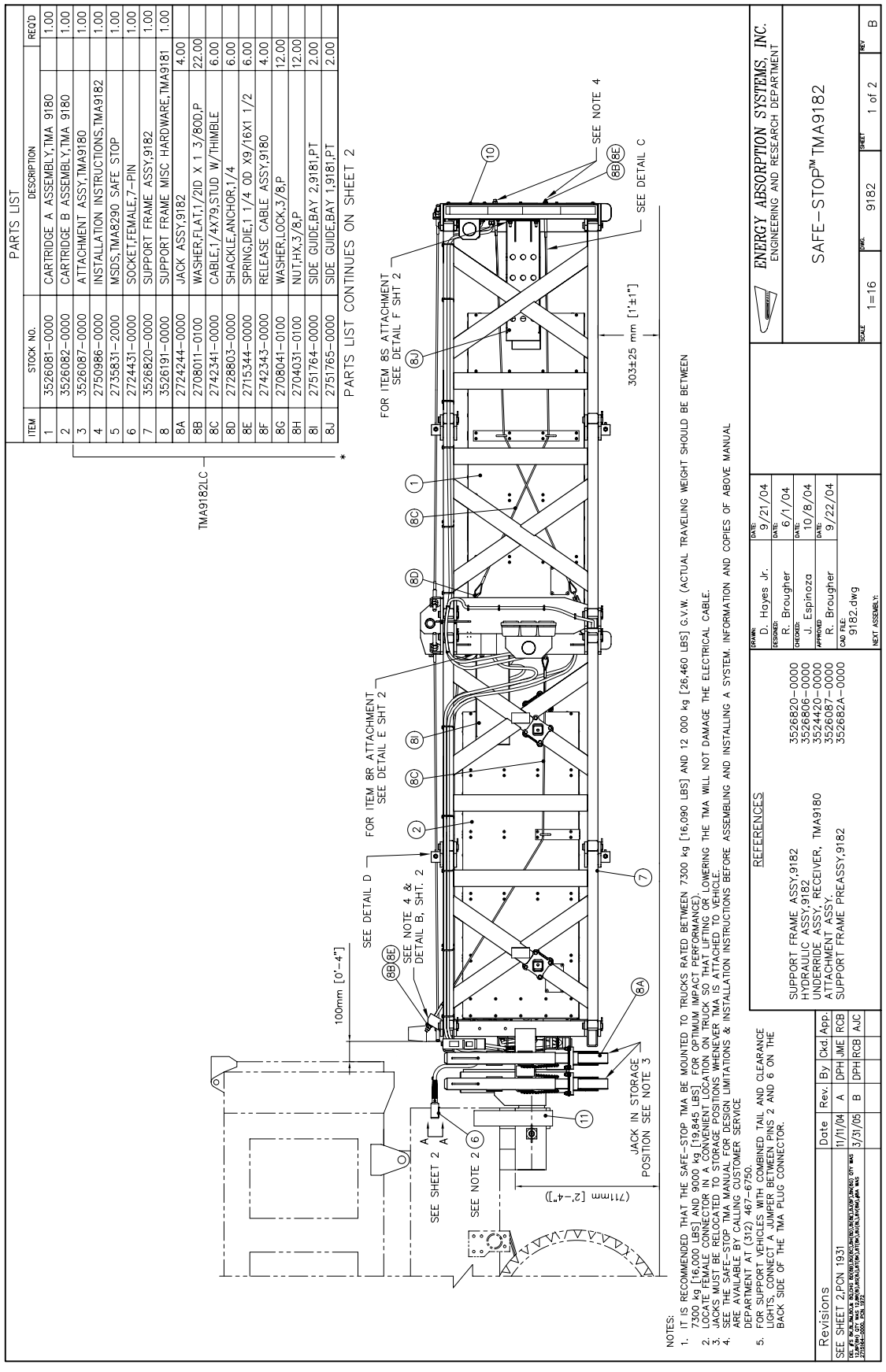
The pump motor and all controls have a negative ground.

5. ELECTRICAL SHORTS OR OPEN CIRCUITS

A. Shorts occur when wires with power come in contact with a ground. A short will cause a fuse to blow or a wire to burn. Look for pinched or cut wires.

B. An open circuit is simply a break which prohibits current flow. Look for pinched or cut wires.

Safe-Stop® 180 TMA


PARTS LIST
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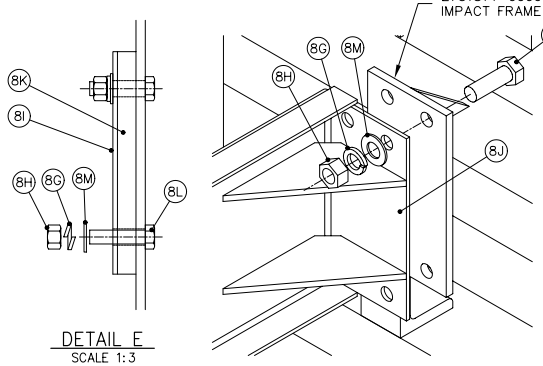
1 | 3526081-0000 | CARTRIDGE A ASSEMBLY,TMA 9180 | 1.00
2 | 3526082-0000 | CARTRIDGE B ASSEMBLY,TMA 9180 | 1.00
3 | 3526087-0000 | ATTACHMENT ASSY,TMA9180 | 1.00
4 | 2750986-0000 | INSTALLATION INSTRUCTIONS,TMA9182 | 1.00
5 | 2735831-2000 | MSDS,TMA8290 SAFE STOP | 1.00
6 | 2724431-0000 | SOCKET,FEMALE,7-PIN | 1.00
7 | 3526820-0000 | SUPPORT FRAME ASSY,9182 | 1.00
8 | 3526191-0000 | SUPPORT FRAME MISC HARDWARE,TMA9181 | 1.00
8A | 2724244-0000 | JACK ASSY,9182 | 4.00
8B | 2708011-0100 | WASHER,FLAT,1/2ID X 1 3/8OD,P | 22.00
8C | 2742341-0000 | CABLE,1/4X79,STUD W/THIMBLE | 6.00
8D | 2728803-0000 | SHACKLE,ANCHOR,1/4 | 6.00
8E | 2715344-0000 | SPRING,DIE,1 1/4 OD X9/16X1 1/2 | 6.00
8F | 2742343-0000 | RELEASE CABLE ASSY,9180 | 4.00
8G | 2708041-0100 | WASHER,LOCK,3/8,P | 12.00
8H | 2704031-0100 | NUT,HX,3/8,P | 12.00
8I | 2751764-0000 | SIDE GUIDE,BAY 2,9181,PT | 2.00
8J | 2751765-0000 | SIDE GUIDE,BAY 1,9181,PT | 2.00
PARTS LIST CONTINUES ON SHEET 2
TMA9182LC
FOR ITEM 8S ATTACHMENT SEE DETAIL F SHT 2
SEE NOTE 4
SEE DETAIL C
303±25 mm [1'±1"]
FOR ITEM 8R ATTACHMENT SEE DETAIL E SHT 2
SEE DETAIL D
SEE NOTE 4 & DETAIL B, SHT. 2
100mm [0'-4"]
SEE SHEET 2
SEE NOTE 2
711mm [2'-4"]
JACK IN STORAGE POSITION SEE NOTE 3
NOTES:
1. IT IS RECOMMENDED THAT THE SAFE-STOP TMA BE MOUNTED TO TRUCKS RATED BETWEEN 7300 kg [16,090 LBS] AND 12 000 kg [26,460 LBS] G.V.W. (ACTUAL TRAVELING WEIGHT SHOULD BE BETWEEN 7300 kg [16,000 LBS] AND 9000 kg [19,845 LBS] FOR OPTIMUM IMPACT PERFORMANCE).
2. LOCATE FEMALE CONNECTOR IN A CONVENIENT LOCATION ON TRUCK SO THAT LIFTING OR LOWERING THE TMA WILL NOT DAMAGE THE ELECTRICAL CABLE.
3. JACKS MUST BE RELOCATED TO STORAGE POSITIONS WHENEVER TMA IS ATTACHED TO VEHICLE.
4. SEE THE SAFE-STOP TMA MANUAL FOR DESIGN LIMITATIONS & INSTALLATION INSTRUCTIONS BEFORE ASSEMBLING AND INSTALLING A SYSTEM. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (312) 467-6750.
5. FOR SUPPORT VEHICLES WITH COMBINED TAIL AND CLEARANCE LIGHTS, CONNECT A JUMPER BETWEEN PINS 2 AND 6 ON THE BACK SIDE OF THE TMA PLUG CONNECTOR.
REFERENCES
SUPPORT FRAME ASSY,9182 3526820-0000
HYDRAULIC ASSY,9182 3526836-0000
UNDERRIDE ASSY, RECEIVER, TMA9180 3524420-0000
ATTACHMENT ASSY: 3526087-0000
SUPPORT FRAME PREASSY,9182 352682A-0000
DRAWN: D. Hoyes Jr. DATE: 9/21/04
DESIGNED: R. Brougher DATE: 6/1/04
CHECKED: J. Espinoza DATE: 10/8/04
APPROVED: R. Brougher DATE: 9/22/04
CAD FILE: 9182.dwg
NEXT ASSEMBLY:
ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT
SAFE-STOP™ TMA9182
SCALE 1=16 DWG. 9182 SHEET 1 of 2 REV. B
Revisions | Date | Rev. | By | Ckd. | App.
SEE SHEET 2,PCN 1931 | 11/11/04 | A | DPH | JME | RCB
| 3/31/05 | B | DPH | RCB | AJC



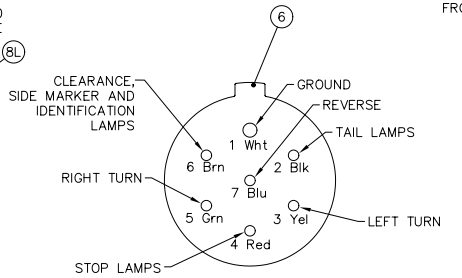
DETAIL E
SCALE 1:3

DETAIL F
SCALE 1:3

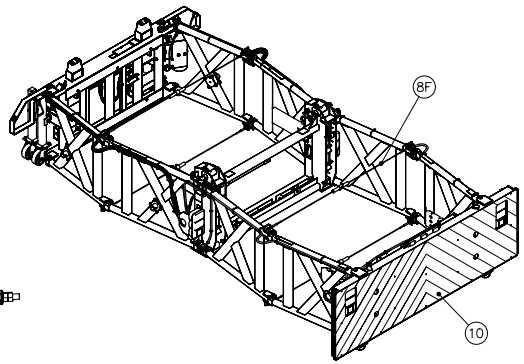
PARTS LIST CONTINUED FROM SHEET 1 *

TMA9182LC

PARTS LIST				
ITEM	STOCK NO.	DESCRIPTION		REQ'D
8K	2708314-0000	WASHER BAR,1/2X1X6,PT	2.00	
8L	2699491-0100	BOLT,HX,3/8X1 1/2,G5,P	12.00	
8M	2708021-0100	WASHER,FLAT,3/8X1,P	12.00	
9	3526804-0000	CONTROL BOX ASSY,CAB,9182		1.00
10	3526088-0000	IMPACT FRAME PLATE ASSY,9180		1.00
11	3524420-0000	UNDERRIDE ASSY,RECEIVER,TMA		1.00



VIEW A-A
(BACK SIDE OF SOCKET)
SEE NOTE 5, SHEET 1
N.T.S.



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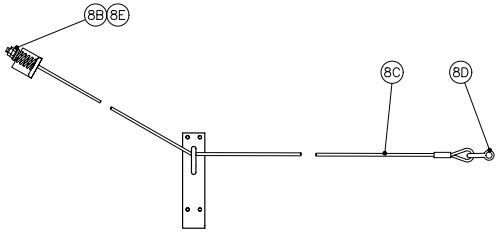
SCALE 1:40



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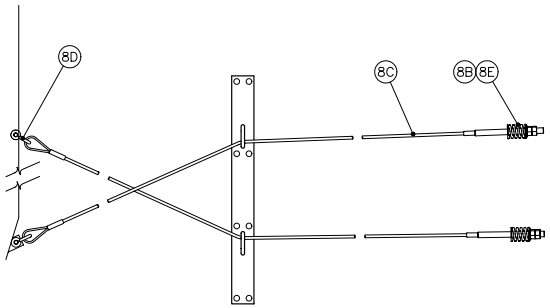

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Revisions	Date	Rev.	By	Ckd.	App.
SWITCHED L & R TURN IN VIEW A-A,PCN 1931	11/11/04	A	DPH	JME	RCB
DEL #'S 8K,8L,8M,8O,& 8Q,CHG 8D(8B),8G(8C),8H(8D),8I(8E),8J(8F),8N(8G) QTY WAS 12,8P(8H) QTY WAS 12,8R(8I),8S(8J),8T(8K),8T(8K),8U(8L),8V(8M),#8A WAS 2715184-0000,PCN 1972	3/31/05	B	DPH	RCB	AJC

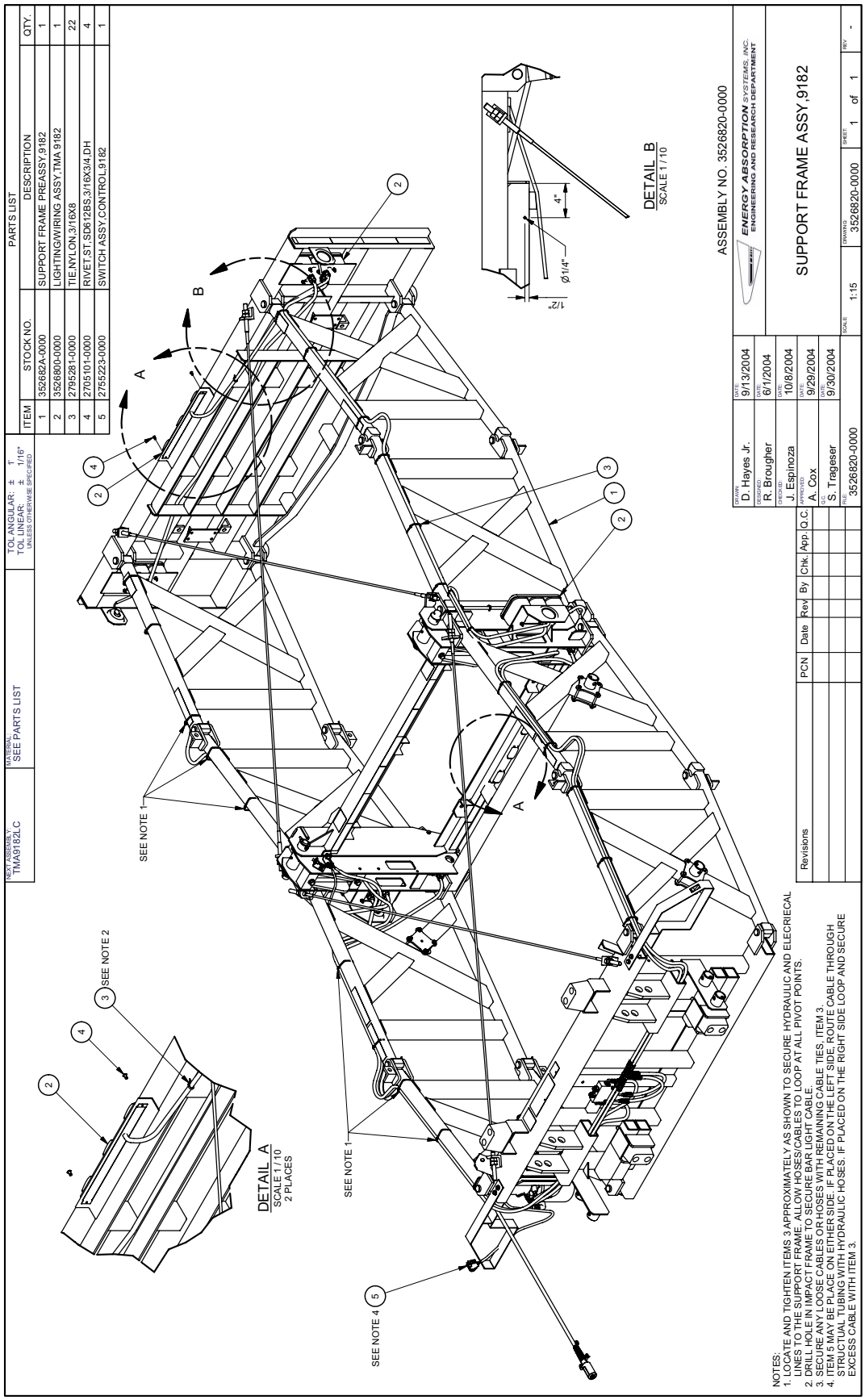
REFERENCES

DRAWN: D. Hayes Jr.	DATE: 9/21/04	
DESIGNED: R. Brougher	DATE: 6/1/04	
CHECKED: J. Espinoza	DATE: 10/8/04	
APPROVED: R. Brougher	DATE: 9/22/04	
CAD FILE: 9182-2.dwg		
NEXT ASSEMBLY:		

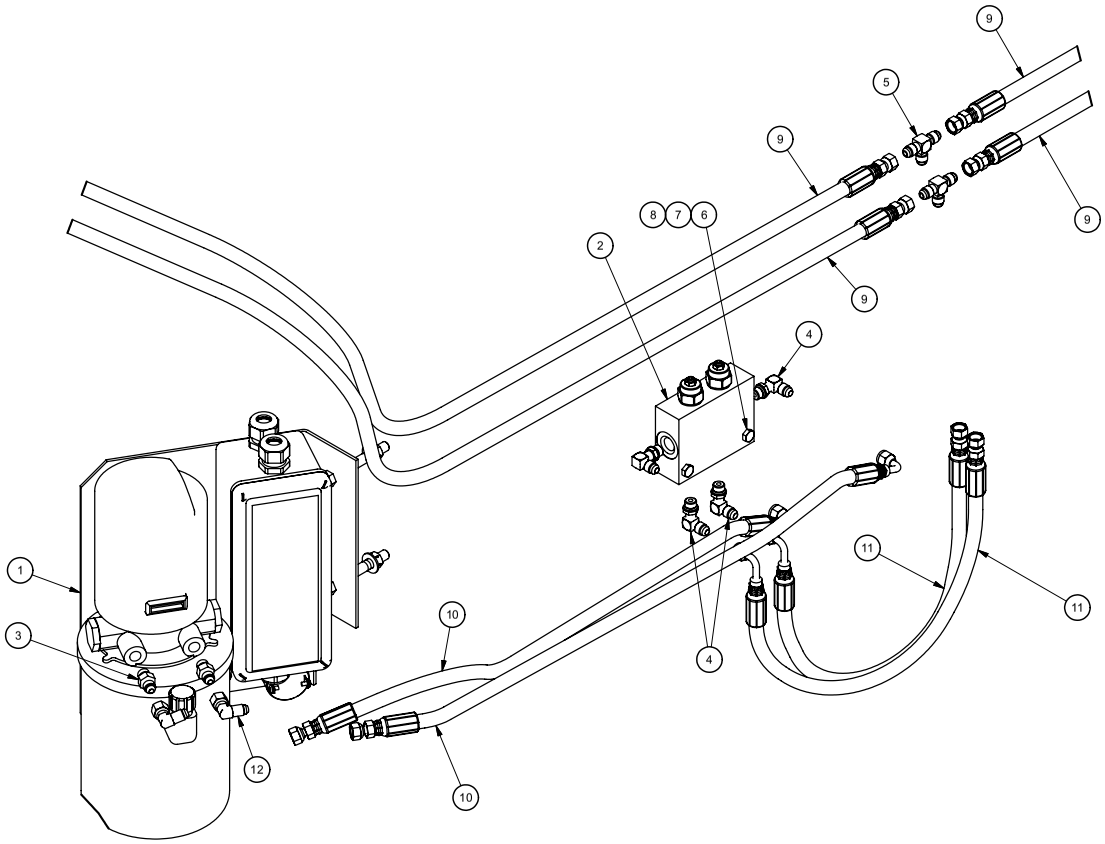
ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

SAFE-STOP™ TMA9182

SCALE	DWG.	SHEET	REV
AS NOTED	9182	2 of 2	B


NEXT ASSEMBLY
TMA9182LC
MATERIAL
SEE PARTS LIST
TOL ANGULAR: ± 1°
TOL LINEAR: ± 1/16"
UNLESS OTHERWISE SPECIFIED
PARTS LIST
ITEM | STOCK NO. | DESCRIPTION | QTY.
1 | 352682A-0000 | SUPPORT FRAME PREASSY,9182 | 1
2 | 3526800-0000 | LIGHTING/WIRING ASSY,TMA 9182 | 1
3 | 2795281-0000 | TIE,NYLON,3/16X8 | 22
4 | 2705101-0000 | RIVET,ST,SD612BS,3/16X3/4,DH | 4
5 | 2755223-0000 | SWITCH ASSY,CONTROL,9182 | 1
ASSEMBLY NO. 3526820-0000
ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT
SUPPORT FRAME ASSY,9182
DRAWN D. Hayes Jr. 9/13/2004
DESIGNED R. Brougher 6/1/2004
CHECKED J. Espinoza 10/8/2004
APPROVED A. Cox 9/29/2004
Q.C. S. Tragesser 9/30/2004
SCALE 1:15
DRAWING 3526820-0000
SHEET 1 of 1
REV -
Revisions
PCN | Date | Rev | By | Chk. | App. | Q.C.
SEE NOTE 1
SEE NOTE 2
SEE NOTE 4
DETAIL A
SCALE 1 / 10
2 PLACES
DETAIL B
SCALE 1 / 10
4"
Ø1/4"
1/2"
NOTES:
1. LOCATE AND TIGHTEN ITEMS 3 APPROXIMATELY AS SHOWN TO SECURE HYDRAULIC AND ELECRIECAL LINES TO THE SUPPORT FRAME. ALLOW HOSES/CABLES TO LOOP AT ALL PIVOT POINTS.
2. DRILL HOLE IN IMPACT FRAME TO SECURE BAR LIGHT CABLE.
3. SECURE ANY LOOSE CABLES OR HOSES WITH REMAINING CABLE TIES, ITEM 3.
4. ITEM 5 MAY BE PLACED ON EITHER SIDE. IF PLACED ON THE LEFT SIDE, ROUTE CABLE THROUGH EXCESS CABLE WITH ITEM 3.
ITEM 5 MAY BE PLACED ON EITHER SIDE. IF PLACED ON THE LEFT SIDE, ROUTE CABLE THROUGH EXCESS CABLE WITH ITEM 3. IF PLACED ON THE RIGHT SIDE, ROUTE CABLE THROUGH EXCESS CABLE WITH HYDRAULIC HOSES.

NEXT ASSEMBLY:	MATERIAL:	TOL ANGULAR: ± 1°
352682A-0000	SEE PARTS LIST	TOL LINEAR: ± 1/16"
		UNLESS OTHERWISE SPECIFIED



PARTS LIST

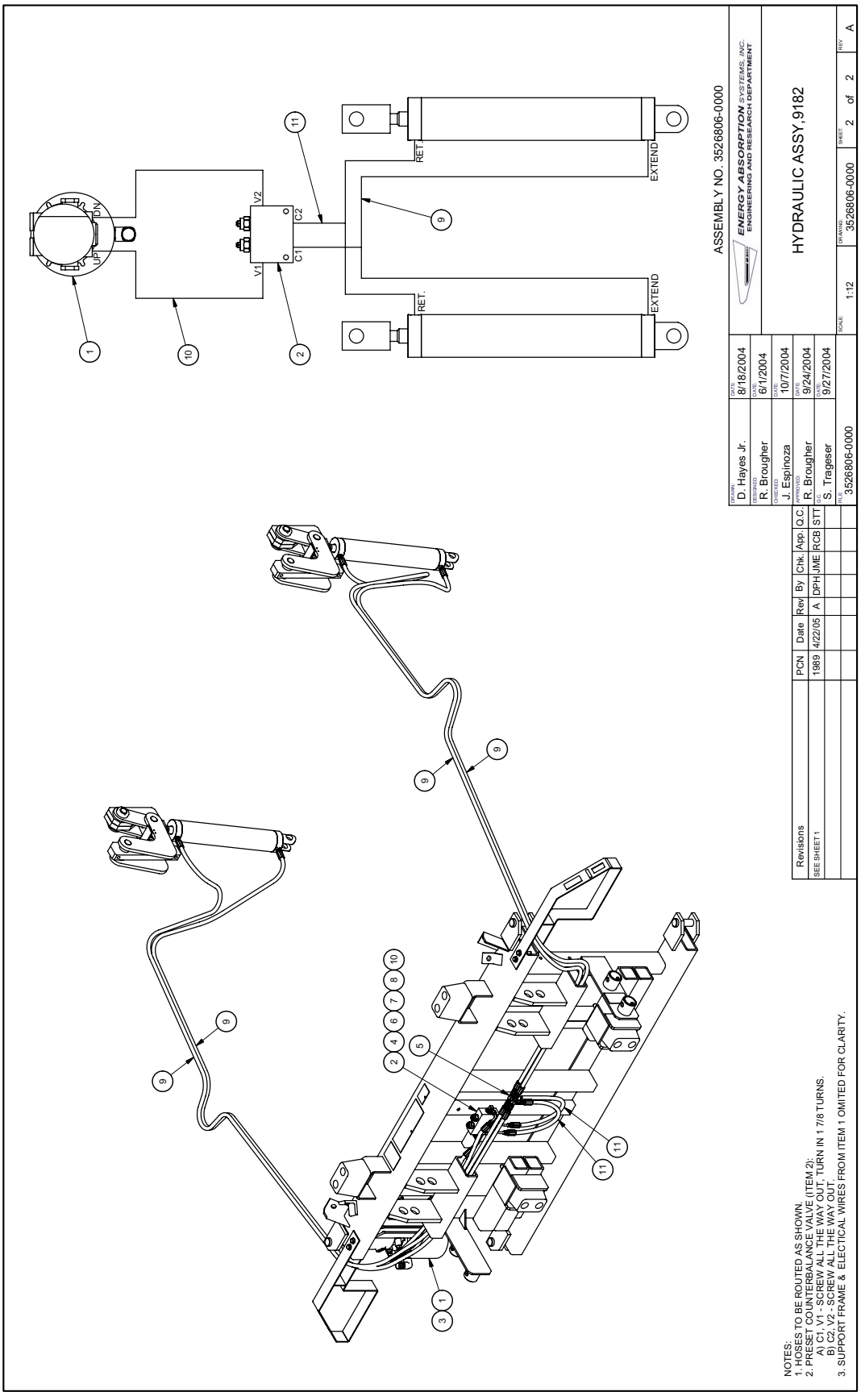
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	3526807-0000	HYDRAULIC PUMP ASSY,9182	1
2	2703001-0000	VALVE,HYDRAULIC,COUNTER BALANCE	1
3	2715315-0100	COUPLING,#4 MORB X #4 MJIC,P	2
4	2703004-0100	ELBOW,#4 M-JICX#6 M-ORB,P	4
5	2715316-0100	TEE,#4 M-JIC,P	2
6	2699141-0100	BOLT,HX,1/4X1 3/4,G2,P	2
7	2708003-0100	WASHER,FLAT,1/4X5/8,P	2
8	2704153-0100	NUT,HX,NYLON LOCK,1/4,P	2
9	2703003-0140	HOSE ASSY,HYDRAULIC,M/F ENDS,140	4
10	2715329-0000	HOSE ASSY,HYDR,30,PUMP SUP	2
11	2715319-0000	HOSE ASSY,HYDRAULIC,16, CYL TOP	2
12	2715335-0100	ELBOW,#4M-JIC X #4F-JIC-S,P	2

ASSEMBLY NO. 3526806-0000

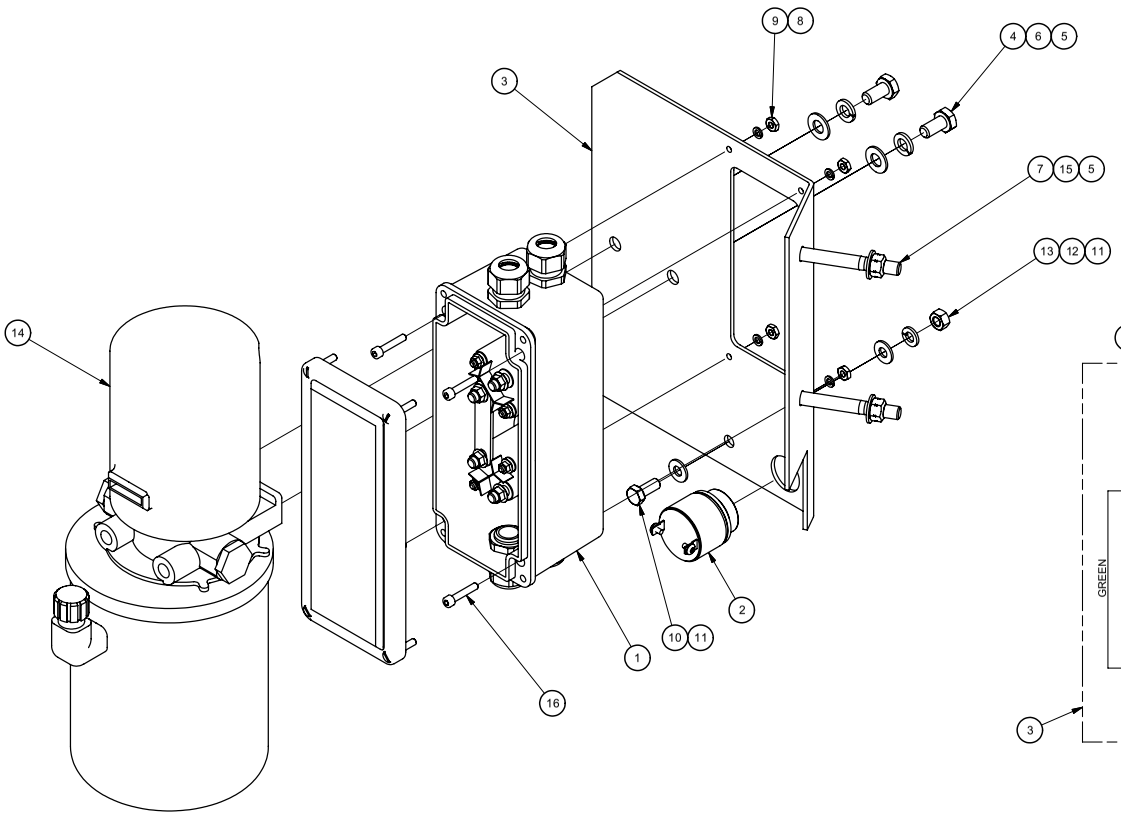
NOTES:
1. SEE SHEET 2 FOR INSTALLATION DETAILS.
2. ELECTRICAL WIRES FROM ITEM 1 OMITTED FOR CLARITY.

Revisions	PCN	Date	Rev	By	Chk.	App.	Q.C.
ADD # 12	1989	4/22/05	A	DPH	JME	RCB	STT

DRAWN: D. Hayes Jr.	DATE: 8/18/2004	ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT
DESIGNED: R. Brougher	DATE: 6/1/2004	
CHECKED: J. Espinoza	DATE: 10/7/2004	HYDRAULIC ASSY,9182
APPROVED: R. Brougher	DATE: 9/24/2004	
Q.C. S. Trageser	DATE: 9/27/2004	
FILE: 3526806-0000	SCALE: 1:8	DRAWING: 3526806-0000 SHEET: 1 of 2 REV: A

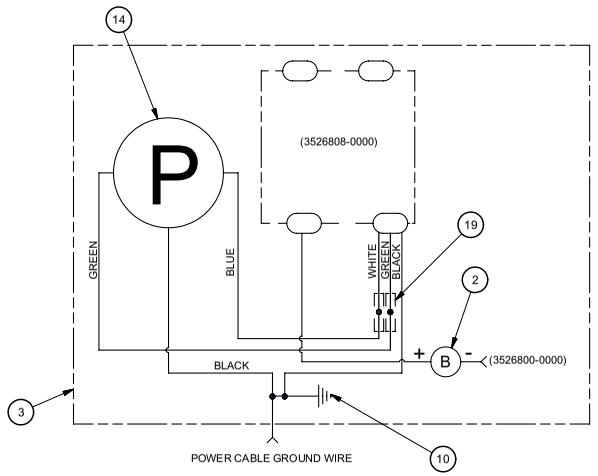

ASSEMBLY NO. 3526806-0000
HYDRAULIC ASSY,9182
ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT
DRAWN D. Hayes Jr. 8/18/2004
ENGINEER R. Brougher 6/1/2004
CHECKED J. Espinoza 10/7/2004
APPROVED R. Brougher 9/24/2004
Q.C. S. Trageser 9/27/2004
SCALE 1:12
DRAWING 3526806-0000
SHEET 2 of 2
REV A
P.O. # 3526806-0000
Revisions
SEE SHEET 1
PCN 1989
Date 4/22/05
Rev A
By DPH
Chk. JME
App. RCB
Q.C. STT
EXTEND
RET.
EXTEND
RET.
IN
OUT
V1
V2
C1
C2
NOTES:
1. HOSES TO BE ROUTED AS SHOWN.
2. PRESET COUNTERBALANCE VALVE (ITEM 2):
A) C1, V1 - SCREW ALL THE WAY OUT, TURN IN 1 7/8 TURNS.
B) C2, V2 - SCREW ALL THE WAY OUT.
3. SUPPORT FRAME & ELECTICAL WIRES FROM ITEM 1 OMITED FOR CLARITY.

NEXT ASSEMBLY:	MATERIAL:	TOL ANGULAR: ± 1°
3526806-0000	SEE PARTS LIST	TOL LINEAR: ± 1/16"
		UNLESS OTHERWISE SPECIFIED



PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY.
1	3526808-0000	ELECTRICAL BOX,HYDRAULIC PUMP	1
2	2757857-0000	BUZZER,6-28V,80-95DB	1
3	2715401-0000	BRACKET,PUMP,TMA 9182,PT	1
4	2701020-0000	BOLT,HX,3/8X3/4,G	2
5	2708021-0100	WASHER,FLAT,3/8X1,P	4
6	2708041-0100	WASHER,LOCK,3/8,P	2
7	2701311-0100	BOLT,HX,3/8X3,G2,P	2
8	2708601-0300	WASHER,LOCK,#10,S	4
9	2704861-0300	NUT,HX,#10-32,S	4
10	2700971-0100	BOLT,HX,5/16X3/4,G2,P	1
11	2708131-0100	WASHER,FLAT,5/16 X 11/16,P	2
12	2708171-0100	WASHER,LOCK,5/16,P	1
13	2704081-0100	NUT,HX,5/16,P	1
14	2723671-0000	PUMP,MARINE GD,VERT,12V	1
15	2704243-0100	NUT,HX,LOCK,3/8,GC,P	2
16	2706812-0300	SCREW,SOCKET HD,10-32X1,S	4
19	2020961-0000	WRAP,SHRINK,1/4	6

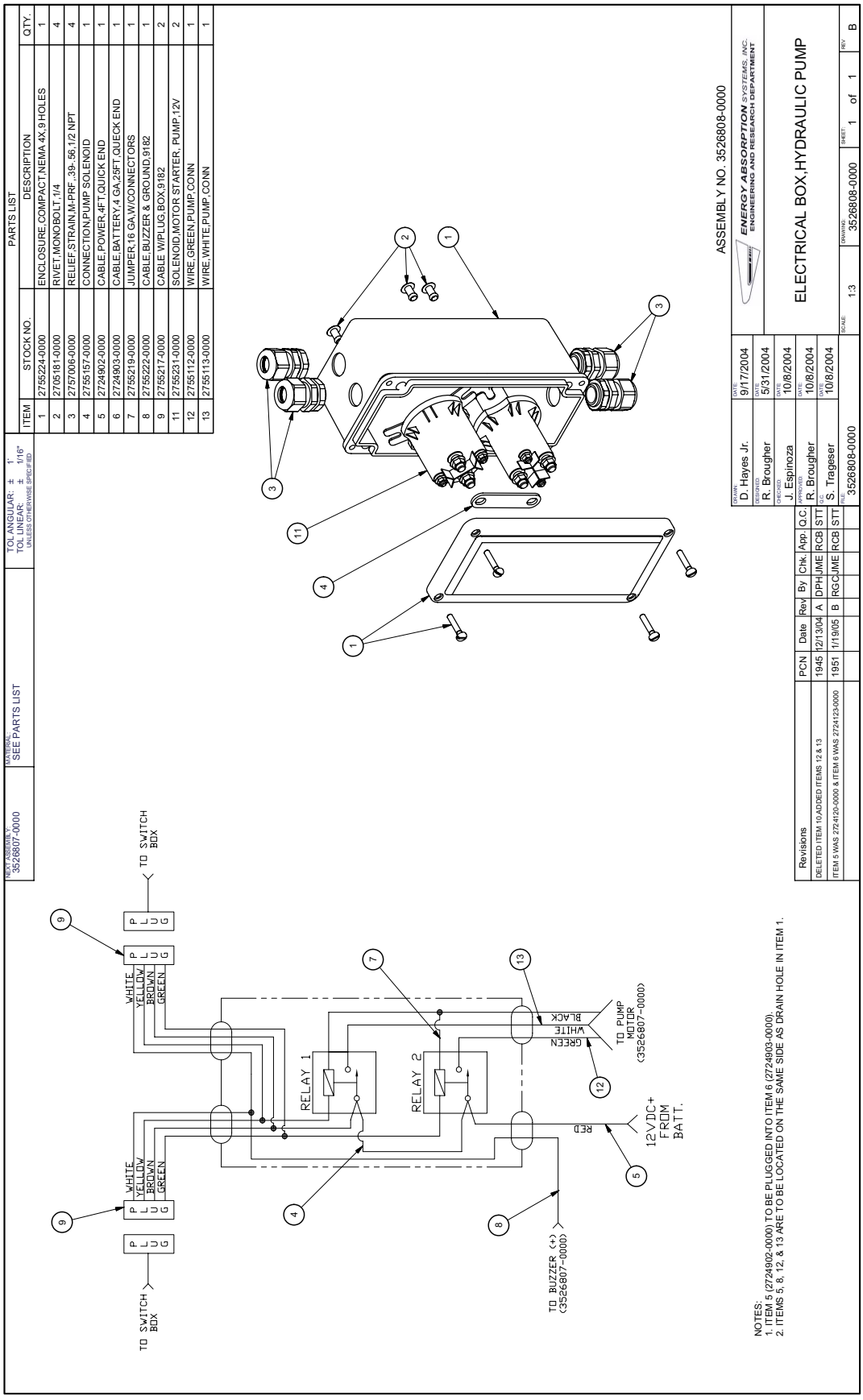


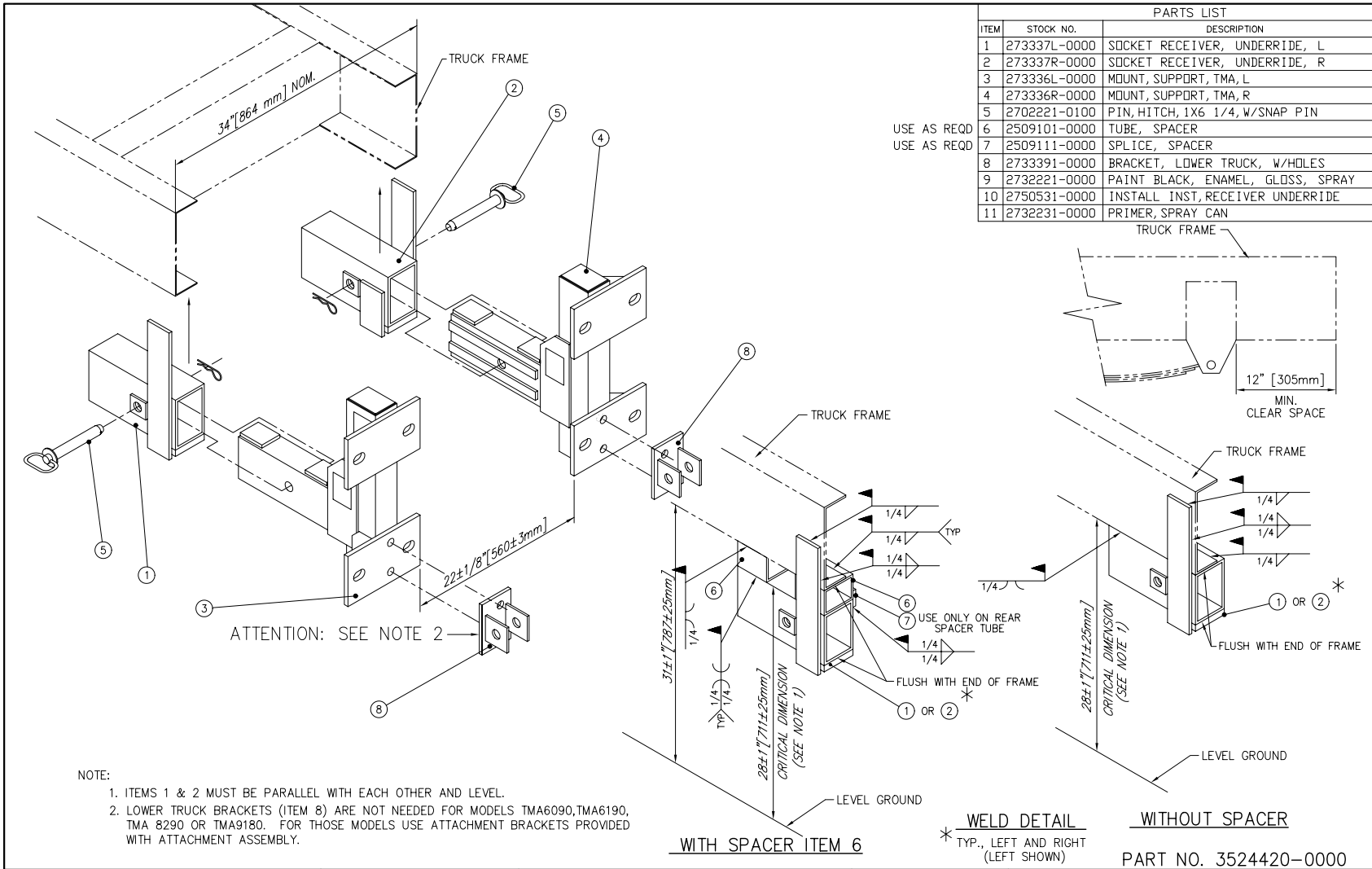
ASSEMBLY NO. 3526807-0000

NOTES:
1. CABLES AND WIRES NOT SHOWN FOR CLARITY.
2. DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.

Revisions	PCN	Date	Rev	By	Chk.	App.	Q.C.
WHITE WIRE WAS BLUE	1945	12/13/04	A	DPH	JME	RCB	STT
DELETE ITEMS 17 & 18	1951	1/19/05	B	RGC	JME	RCB	STT

DRAWN: R. Cummins	DATE: 9/20/2004	ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT
DESIGNED: R. Brougher	DATE: 5/31/2004	
CHECKED: J. Espinoza	DATE: 10/8/2004	
APPROVED: R. Brougher	DATE: 9/30/2004	HYDRAULIC PUMP ASSY, 9182
Q.C.: S. Trageser	DATE: 9/30/2004	
FILE: 3526807-0000	SCALE: 1:3	DRAWING: 3526807-0000 SHEET: 1 of 1 REV: B


PARTS LIST
ITEM | STOCK NO. | DESCRIPTION | QTY.
1 | 2755224-0000 | ENCLOSURE,COMPACT,NEMA 4X,9 HOLES | 1
2 | 2705181-0000 | RIVET,MONOBOLT,1/4 | 4
3 | 2757006-0000 | RELIEF,STRAIN,M-PRF,.39-.56,1/2 NPT | 4
4 | 2755157-0000 | CONNECTION,PUMP SOLENOID | 1
5 | 2724902-0000 | CABLE,POWER,4FT,QUICK END | 1
6 | 2724903-0000 | CABLE,BATTERY,4 GA,25FT,QUECK END | 1
7 | 2755219-0000 | JUMPER,16 GA,W/CONNECTORS | 1
8 | 2755222-0000 | CABLE,BUZZER & GROUND,9182 | 1
9 | 2755217-0000 | CABLE W/PLUG,BOX,9182 | 2
11 | 2755231-0000 | SOLENOID,MOTOR STARTER, PUMP,12V | 2
12 | 2755112-0000 | WIRE,GREEN,PUMP,CONN | 1
13 | 2755113-0000 | WIRE,WHITE,PUMP,CONN | 1
NEXT ASSEMBLY: 3526807-0000
MATERIAL: SEE PARTS LIST
TOL ANGULAR: ± 1°
TOL LINEAR: ± 1/16"
UNLESS OTHERWISE SPECIFIED
ASSEMBLY NO. 3526808-0000
ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT
ELECTRICAL BOX,HYDRAULIC PUMP
DRAWN: D. Hayes Jr. DATE: 9/17/2004
ENGINEER: R. Brougher DATE: 5/31/2004
APPROVED: J. Espinoza DATE: 10/8/2004
Revisions | PCN | Date | Rev | By | Chk. | App. | Q.C.
DELETED ITEM 10 ADDED ITEMS 12 & 13 | 1945 | 12/13/04 | A | DPH | JME | RCB | STT | R. Brougher | 10/8/2004
ITEM 5 WAS 2724120-0000 & ITEM 6 WAS 2724123-0000 | 1951 | 1/19/05 | B | RGC | JME | RCB | STT | S. Trageser | 10/8/2004
SCALE: 1:3
DRAWING: 3526808-0000
SHEET: 1 of 1
REV: B
TO SWITCH BOX
WHITE
YELLOW
BROWN
GREEN
PLUG
RELAY 1
RELAY 2
TO PUMP MOTOR (3526807-0000)
BLACK
WHITE
GREEN
RED
12VDC+ FROM BATT.
TO BUZZER (+) (3526807-0000)
NOTES:
1. ITEM 5 (2724902-0000) TO BE PLUGGED INTO ITEM 6 (2724903-0000).
2. ITEMS 5, 8, 12, & 13 ARE TO BE LOCATED ON THE SAME SIDE AS DRAIN HOLE IN ITEM 1.



WITH SPACER ITEM 6

WITHOUT SPACER

PART NO. 3524420-0000

WELD DETAIL
TYP., LEFT AND RIGHT (LEFT SHOWN)

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	REQ'D
1	273337L-0000	SOCKET RECEIVER, UNDERRIDE, L	1.00
2	273337R-0000	SOCKET RECEIVER, UNDERRIDE, R	1.00
3	273336L-0000	MOUNT, SUPPORT, TMA, L	1.00
4	273336R-0000	MOUNT, SUPPORT, TMA, R	1.00
5	2702221-0100	PIN, HITCH, 1X6 1/4, W/SNAP PIN	2.00
USE AS REQD 6	2509101-0000	TUBE, SPACER	4.00
USE AS REQD 7	2509111-0000	SPLICE, SPACER	2.00
8	2733391-0000	BRACKET, LOWER TRUCK, W/HOLES	2.00
9	2732221-0000	PAINT BLACK, ENAMEL, GLOSS, SPRAY	1.00
10	2750531-0000	INSTALL INST, RECEIVER UNDERRIDE	1.00
11	2732231-0000	PRIMER, SPRAY CAN	1.00

NOTE:
1. ITEMS 1 & 2 MUST BE PARALLEL WITH EACH OTHER AND LEVEL.
2. LOWER TRUCK BRACKETS (ITEM 8) ARE NOT NEEDED FOR MODELS TMA6090,TMA6190, TMA 8290 OR TMA9180. FOR THOSE MODELS USE ATTACHMENT BRACKETS PROVIDED WITH ATTACHMENT ASSEMBLY.

Revisions	Date	Rev.	By	Ckd.	App.	Q.C.
ADDED NOTE 1	8/5/94	A	KM	STT	SPT	DLJ
ADDED ITEM 10, 2750531-0000	10/14/94	B	STT	KM	SPT	JMT
ADDED NOTE 2 AND ITEM 11	11/7/94	C	JE	//	//	//
ITEM 9 WAS YELLOW	5/21/96	D	RGC	STT	SPT	DLJ
ADDED GUSSETS TO ITEMS 3 & 4	06/09/97	E	RGC	BB	SPT	STT
ITEM 5 WAS 2702221-0000	11/28/00	F	LWC	BK	KM	STT
Added TMA8290 AND 9180 TO NOTE 2.	11/04/02	G	STT	KM	AAP	KM

		Date
Designed		
Drawn	Bob Darling	08/25/93
Checked	STRAGESER	09/30/93
Approved	D June	08/18/94
Q.C.	J.M. Thompson	09/30/93

Tolerances:
a. Angular ± 1°
b. Linear ± 1/16"
(Unless Otherwise Noted)

Material:
SEE PART DRAWINGS

REFERENCES

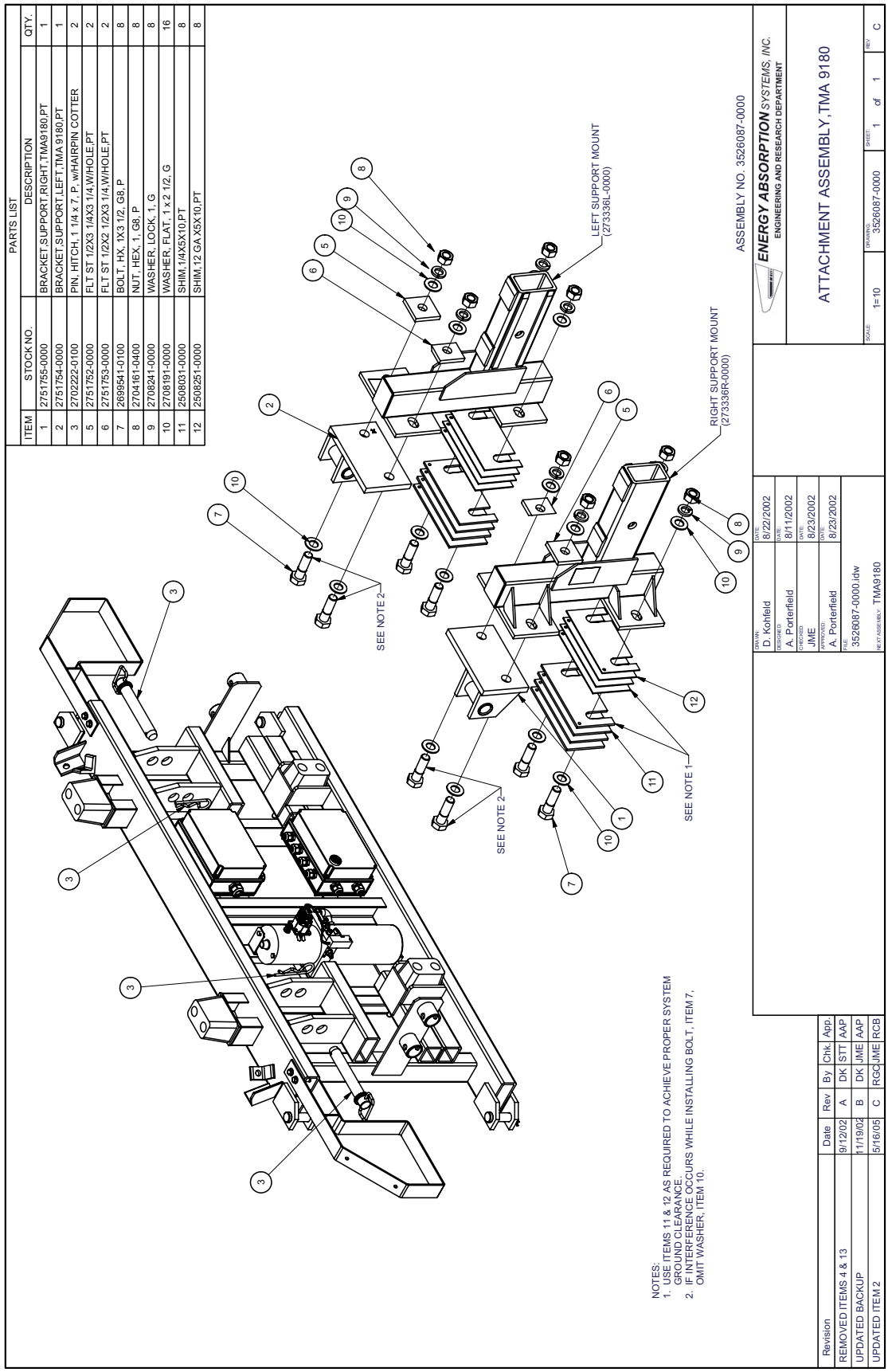
NEXT ASSEMBLY _____

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

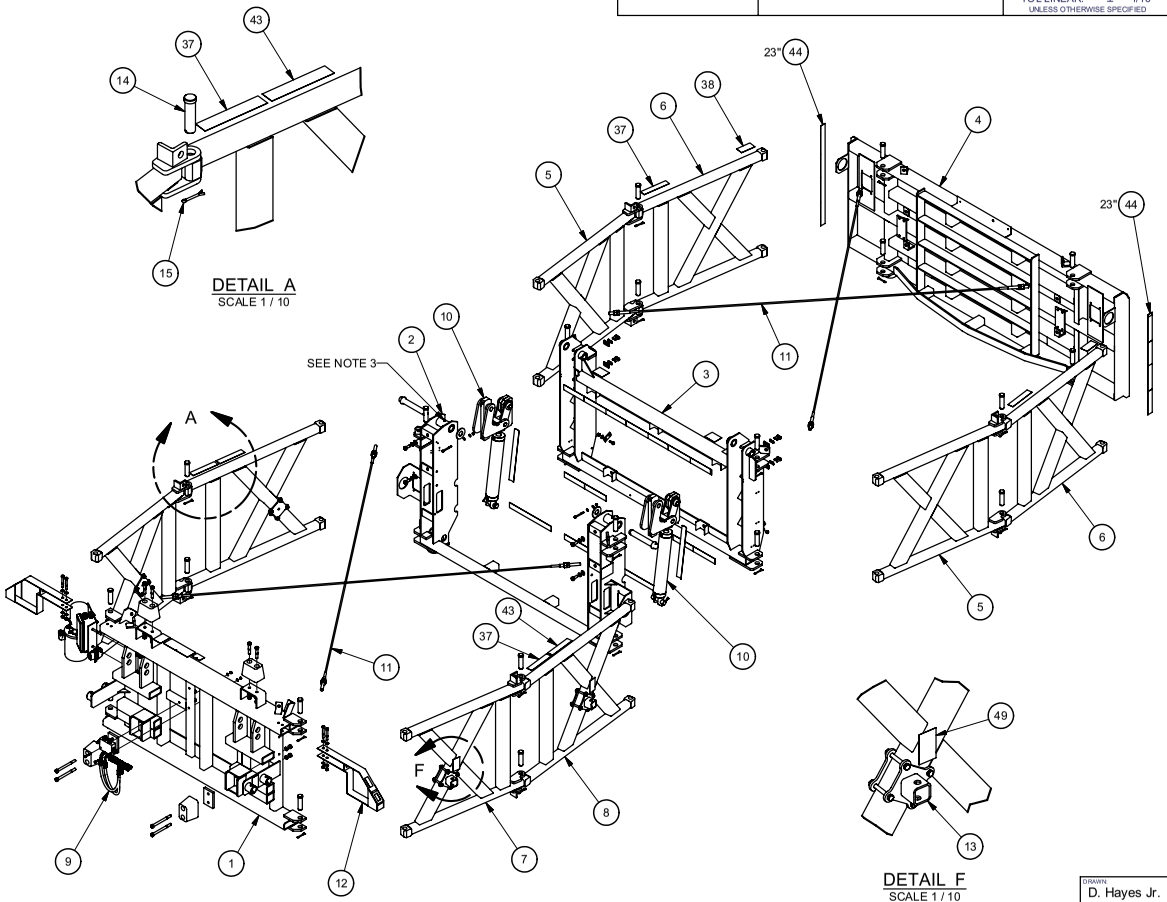
UNDERRIDE ASSY,RECEIVER,TMA

SCALE	SIZE	DWG. NUMBER	SHEET	REV
(1:8) 1/8"=1"	C	3524420-0000	1 OF 1	G

Safe-Stop® 180 TMA


PARTS LIST
ITEM | STOCK NO. | DESCRIPTION | QTY.
1 | 2751755-0000 | BRACKET,SUPPORT,RIGHT,TMA9180,PT | 1
2 | 2751754-0000 | BRACKET,SUPPORT,LEFT,TMA 9180,PT | 1
3 | 2702222-0100 | PIN, HITCH,1 1/4 x 7, P, w/HAIRPIN COTTER | 2
5 | 2751752-0000 | FLT ST 1/2X3 1/4X3 1/4,W/HOLE,PT | 2
6 | 2751753-0000 | FLT ST 1/2X2 1/2X3 1/4,W/HOLE,PT | 2
7 | 2699541-0100 | BOLT, HX, 1X3 1/2, G8, P | 8
8 | 2704161-0400 | NUT, HEX, 1, G8, P | 8
9 | 2708241-0000 | WASHER, LOCK, 1, G | 8
10 | 2708191-0000 | WASHER, FLAT, 1 x 2 1/2, G | 16
11 | 2508031-0000 | SHIM,1/4X5X10,PT | 8
12 | 2508251-0000 | SHIM,12 GA,X5X10,PT | 8
LEFT SUPPORT MOUNT (273336L-0000)
RIGHT SUPPORT MOUNT (273336R-0000)
SEE NOTE 2
SEE NOTE 1
ASSEMBLY NO. 3526087-0000
NOTES:
1. USE ITEMS 11 & 12 AS REQUIRED TO ACHIEVE PROPER SYSTEM GROUND CLEARANCE.
2. IF INTERFERENCE OCCURS WHILE INSTALLING BOLT, ITEM 7, OMIT WASHER, ITEM 10.
Revision | Date | Rev | By | Chk. | App.
REMOVED ITEMS 4 & 13 | 9/12/02 | A | DK | STT | AAP
UPDATED BACKUP | 11/19/02 | B | DK | JME | AAP
UPDATED ITEM 2 | 5/16/05 | C | RGC | JME | RCB
DRAWN D. Kohfeld 8/22/2002
ENGINEER A. Porterfield 8/11/2002
CHECKED JME 8/23/2002
APPROVED A. Porterfield 8/23/2002
FILE 3526087-0000.idw
NEXT ASSEMBLY TMA9180
ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT
ATTACHMENT ASSEMBLY,TMA 9180
SCALE 1=10
DRAWING 3526087-0000
SHEET 1 of 1
REV C

NEXT ASSEMBLY:	MATERIAL:	TOL ANGULAR: ± 1'
3526820-0000	SEE PARTS LIST	TOL LINEAR: ± 1/16"
		UNLESS OTHERWISE SPECIFIED



PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	2724104-0000	BACKUP,TMA 9182,PT	1
2	2724108-0000	WELDMENT,FRONT INT FRAME,9182,PT	1
3	2724114-0000	WELDMENT,REAR INT FRAME,9181,PT	1
4	2751814-0000	IMPACT FRAME,9181,PT	1
5	2724100-0000	ARM,FRONT,9182,PT	2
6	2724102-0000	ARM,REAR,9182,PT	2
7	2724101-0000	ARM,FRONT,W/MOUNT,9182,PT	2
8	2724103-0000	ARM,REAR,W/MOUNT,9182,PT	2
9	3526806-0000	HYDRAULIC ASSY,9182	1
10	3526805-0000	HYDRAULIC CYLINDER ASSY,9182	2
11	2742340-0000	CABLE,5/16X100,5/8 STUDS	4
12	2724106-0000	GUARD/SWITCH MOUNT,9182,PT	2
13	2724242-0000	JACK BRACKET ASSY,SQ,9182	4
14	2702541-0100	PIN,CLEVIS,1X3 1/2,P	24
15	2702151-0100	PIN,COTTER,3/16X1 1/2,P	24
16	2715402-0100	PIN,HITCH,1 1/4 OD X7,W/OUT HANDLE,P	2
17	2751761-0000	SPACER 1/2X3X4 1/2,W/HOLES,PT	2
18	2021487-0000	BUMPER,RUBBER,3 1/8X5X3.5H,2 HOLES	4
19	2751760-0000	SPACER 1/4X1X2 1/4,W/HOLES,PT	2
20	2708733-0000	WASHER,FLAT,1 1/4 ID X 2 3/4 OD,G	2
21	2701112-0100	BOLT,HX,1/4X2 3/4,G5,P	2
22	2699100-0100	BOLT,HX,3/8X1,G5,P	10
23	2701311-0100	BOLT,HX,3/8X3,G2,P	4
24	2701374-0100	BOLT,HX,1/2X6,G5,P	4
25	2699010-0100	BOLT,HX,1/2X2 3/4,G2,P	4
26	2699008-0100	BOLT,HX,1/2X1 1/4,G5,P	4
27	2708003-0100	WASHER,FLAT,1/4X5/8,P	4
28	2708041-0100	WASHER,LOCK,3/8,P	12
29	2708022-0100	WASHER,FLAT,3/8 ID X13/16 OD,P,HRD	6
30	2708181-0100	WASHER,LOCK,1/2,P	12
31	2708011-0100	WASHER,FLAT,1/2X1 3/8,P	4
32	2704153-0100	NUT,HX,NYLON LOCK,1/4,P	2
33	2704008-0100	NUT,HX,NYLON LOCK,3/8,P	2
34	2704031-0100	NUT,HX,3/8,P	4
35	2704011-0100	NUT,HX,1/2,P	8
36	2715011-0000	GREASE FITTING,1/4-28,STR	2
37	2750089-0000	DECAL,RELEASE CABLE TORQUE,9180	4
38	2725381-0000	DECAL,CAUTION,STAY CLEAR	2
39	2735711-0000	DECAL,CAUTION,ALL PRODUCTS	1
40	2735712-3200	DECAL,PRODUCT,SAFE-STOP 180 TMA	1
41	2750471-0000	DECAL,USE ENERGY REPLACEMENT PARTS	3
42	2750661-0000	DECAL,WARNING,HANDS/FEET CLEAR	2
43	2735512-0000	DECAL,SAFESTOP 9182,APPROVED OPT TESTS	2
44	2712272-0000	TAPE,REFLECTIVE,1 1/2 RED/WHITE	17.3

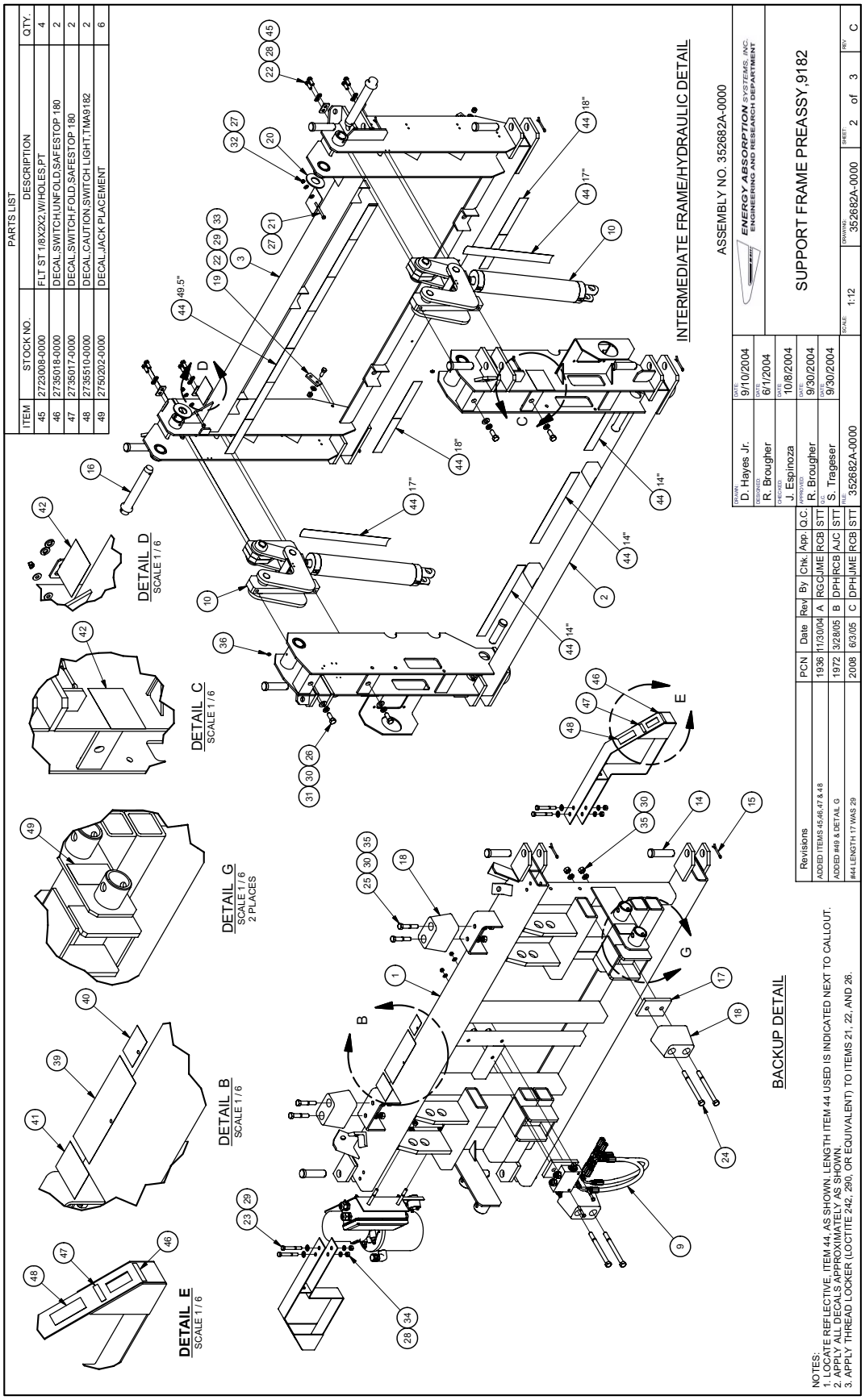
(PARTS LIST CONTINUED ON SHEET 2)

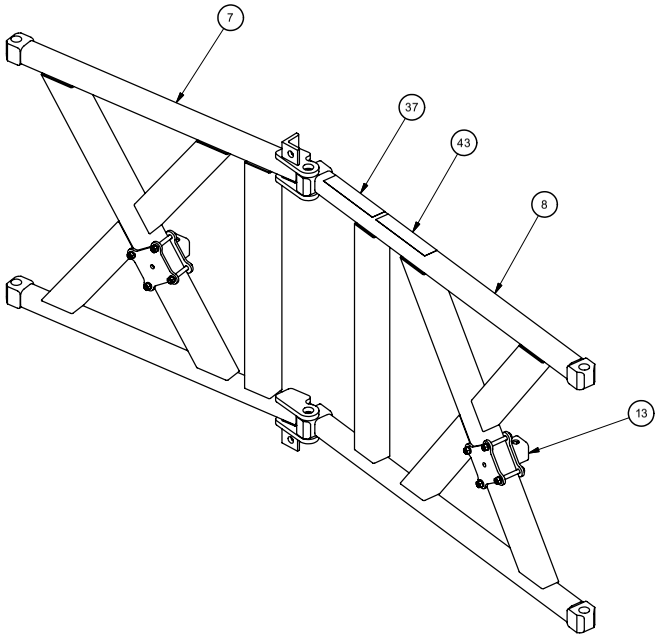
ASSEMBLY NO. 352682A-0000

NOTES:
1. LOCATE ALL DECALS AND REFLECTIVE AS SHOWN. LENGTH OF ITEM 44 IS INDICATED NEXT TO EACH ITEM CALLOUT. SEE SHEETS 2 & 3 FOR ADDITIONAL DECAL AND TAPE PLACEMENT.
2. SEE SHEET 2 FOR ADDITIONAL DECAL DETAILS OF BACKUP AND INTERMIDIATE FRAME DETAILS.
3. AFTER ASSEMBLY FILL AXLE SLEEVES WITH STANDARD BEARING GRASE UNTIL GREASE IS VISIBLE AT ENDS OF SLEEVE.
4. HYDRAULIC HOSES AND ELECTRICAL WIRES FROM ITEM 9 NOT SHOWN FOR CLARITY.

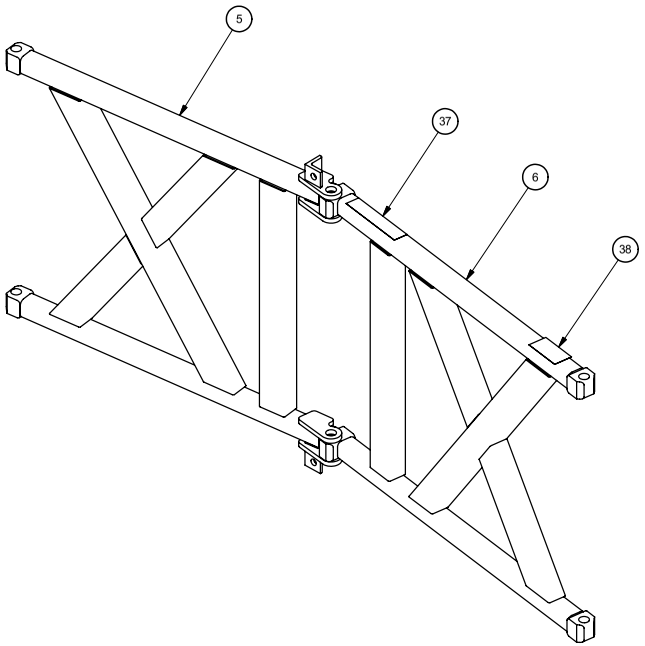
Revisions	PCN	Date	Rev	By	Chk.	App.	Q.C.
ADDED ITEMS 45,46,47 & 48	1936	11/30/04	A	RGC	JME	RCB	STT
ADDED #49 & DETAIL F,#13 WAS 2724128-0000	1972	3/28/05	B	DPH	RCB	AJC	STT
#44 QTY WAS 19.3	2008	6/3/05	C	DPH	JME	RCB	STT

DRAWN: D. Hayes Jr.	DATE: 9/10/2004	ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT
DESIGNED: R. Brougher	DATE: 6/1/2004	
CHECKED: J. Espinoza	DATE: 10/8/2004	
APPROVED: R. Brougher	DATE: 9/30/2004	SUPPORT FRAME PREASSY,9182
Q.C.: S. Trageser	DATE: 9/30/2004	
FILE: 352682A-0000	SCALE: 1:25	DRAWING: 352682A-0000 SHEET: 1 of 3 REV: C


PARTS LIST
ITEM | STOCK NO. | DESCRIPTION | QTY.
45 | 2723008-0000 | FLT ST 1/8X2X2,W/HOLES,PT | 4
46 | 2735018-0000 | DECAL,SWITCH,UNFOLD,SAFESTOP 180 | 2
47 | 2735017-0000 | DECAL,SWITCH,FOLD,SAFESTOP 180 | 2
48 | 2735510-0000 | DECAL,CAUTION,SWITCH LIGHT,TMA9182 | 2
49 | 2750202-0000 | DECAL,JACK PLACEMENT | 6
INTERMEDIATE FRAME/HYDRAULIC DETAIL
ASSEMBLY NO. 352682A-0000
DETAIL D SCALE 1 / 6
DETAIL C SCALE 1 / 6
DETAIL G SCALE 1 / 6 2 PLACES
DETAIL B SCALE 1 / 6
DETAIL E SCALE 1 / 6
BACKUP DETAIL
Revisions | PCN | Date | Rev | By | Chk. | App. | Q.C.
ADDED ITEMS 45,46,47 & 48 | 1936 | 11/30/04 | A | RGC | JME | RCB | STT
ADDED #49 & DETAIL G | 1972 | 3/28/05 | B | DPH | RCB | AJC | STT
#44 LENGTH 17 WAS 29 | 2008 | 6/3/05 | C | DPH | JME | RCB | STT
DRAWN D. Hayes Jr. 9/10/2004
ENGINEERED R. Brougher 6/1/2004
CHECKED J. Espinoza 10/8/2004
APPROVED R. Brougher 9/30/2004
Q.C. S. Trageser 9/30/2004
M.F. 352682A-0000
ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT
SUPPORT FRAME PREASSY,9182
SCALE 1:12
DRAWING 352682A-0000
SHEET 2 of 3
REV C
NOTES:
1. LOCATE REFLECTIVE, ITEM 44, AS SHOWN. LENGTH ITEM 44 USED IS INDICATED NEXT TO CALLOUT.
2. APPLY ALL DECALS APPROXIMATELY AS SHOWN.
3. APPLY THREAD LOCKER (LOCTITE 242, 290, OR EQUIVALENT) TO ITEMS 21, 22, AND 26.



FRONT ARM DETAIL



REAR ARM DETAIL

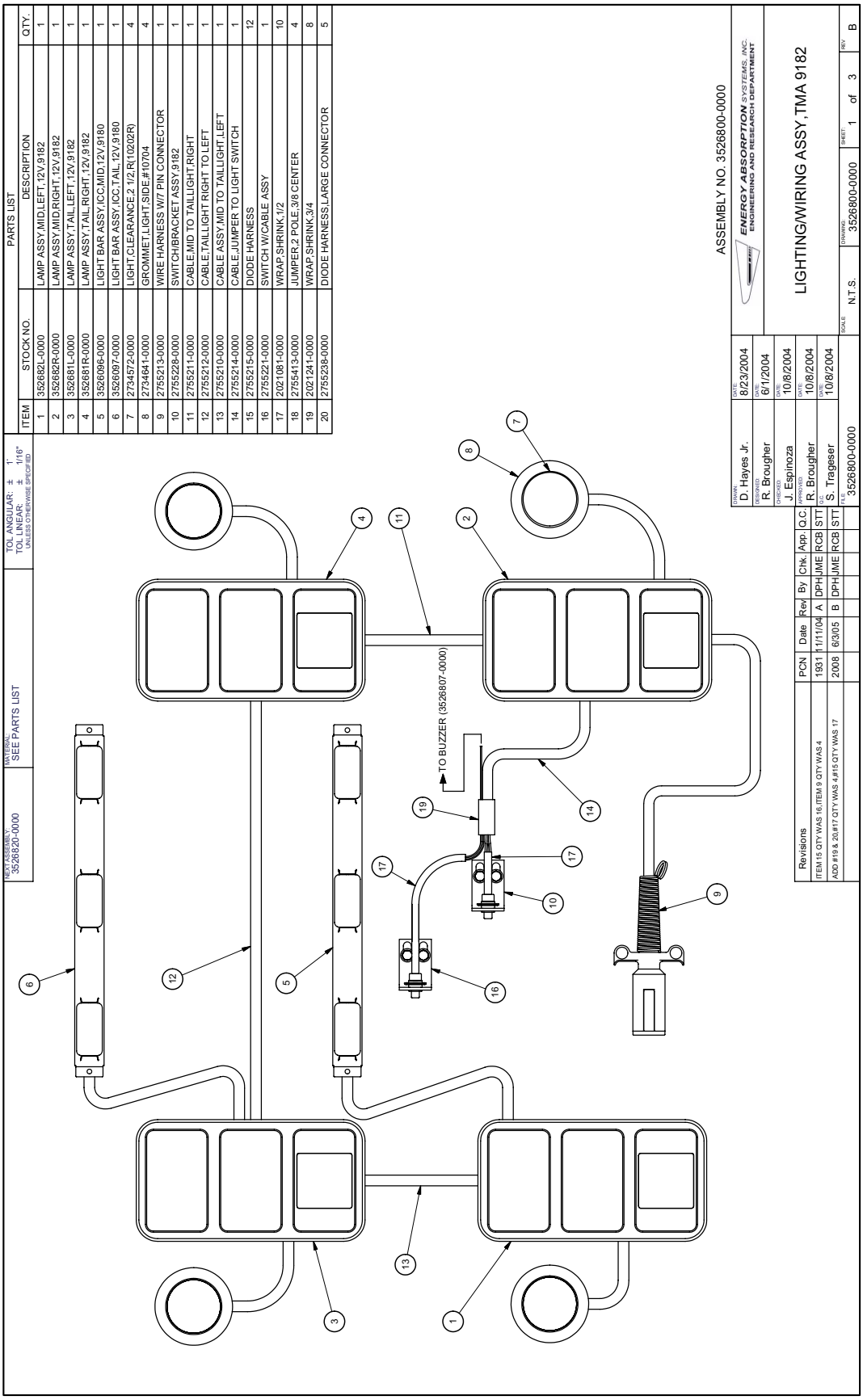
ASSEMBLY NO. 352682A-0000

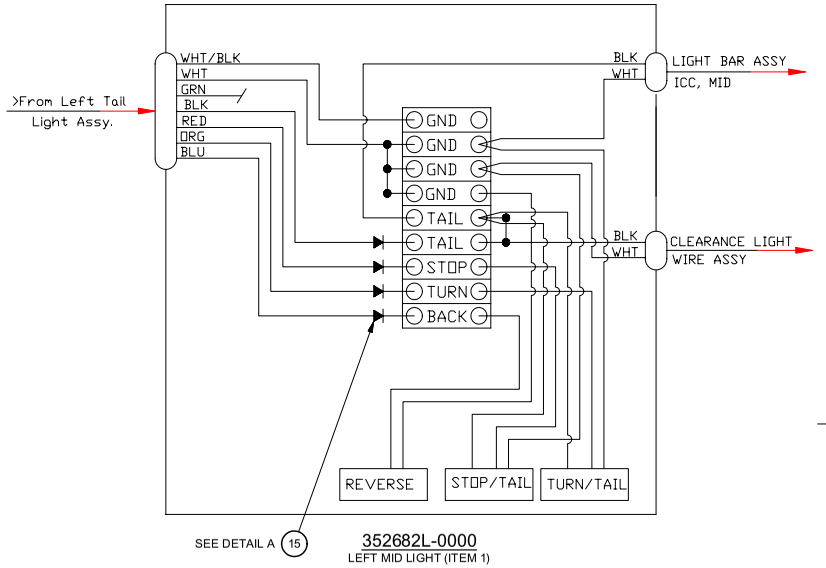
Revisions	PCN	Date	Rev	By	Chk.	App.	Q.C.
SEE SHEET 1	1936	12/14/04	A	RGC	JME	RCB	STT
SEE SHEETS 1 & 2	1972	3/28/05	B	DPH	RCB	AJC	STT
SEE SHEETS 1 & 2	2008	6/3/05	C	DPH	JME	RCB	STT

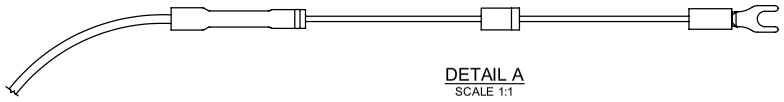
DRAWN: D. Hayes Jr.	DATE: 9/10/2004	ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT
DESIGNED: R. Brougher	DATE: 6/1/2004	
CHECKED: J. Espinoza	DATE: 10/8/2004	SUPPORT FRAME PREASSY,9182
APPROVED: R. Brougher	DATE: 9/30/2004	
Q.C. S. Trageser	DATE: 9/30/2004	
FILE: 352682A-0000		SCALE: 1:10 / DRAWING: 352682A-0000 / SHEET: 3 of 3 / REV: C

NOTES:
1. APPLY ALL DECALS APPROXIMATELY AS SHOWN.

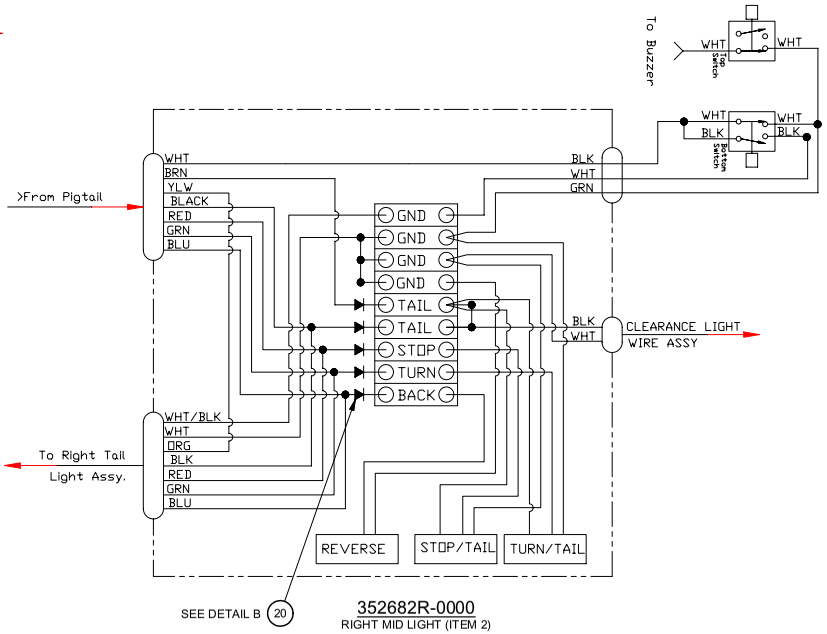
Safe-Stop® 180 TMA


PARTS LIST
ITEM | STOCK NO. | DESCRIPTION | QTY.
1 | 352682L-0000 | LAMP ASSY,MID,LEFT,12V,9182 | 1
2 | 352682R-0000 | LAMP ASSY,MID,RIGHT,12V,9182 | 1
3 | 352681L-0000 | LAMP ASSY,TAIL,LEFT,12V,9182 | 1
4 | 352681R-0000 | LAMP ASSY,TAIL,RIGHT,12V,9182 | 1
5 | 3526096-0000 | LIGHT BAR ASSY,ICC,MID,12V,9180 | 1
6 | 3526097-0000 | LIGHT BAR ASSY,ICC,TAIL,12V,9180 | 1
7 | 2734572-0000 | LIGHT,CLEARANCE,2 1/2,R(10202R) | 4
8 | 2734641-0000 | GROMMET,LIGHT,SIDE,#10704 | 4
9 | 2755213-0000 | WIRE HARNESS W/7 PIN CONNECTOR | 1
10 | 2755228-0000 | SWITCH/BRACKET ASSY,9182 | 1
11 | 2755211-0000 | CABLE,MID TO TAILLIGHT,RIGHT | 1
12 | 2755212-0000 | CABLE,TAILLIGHT RIGHT TO LEFT | 1
13 | 2755210-0000 | CABLE ASSY,MID TO TAILLIGHT,LEFT | 1
14 | 2755214-0000 | CABLE,JUMPER TO LIGHT SWITCH | 1
15 | 2755215-0000 | DIODE HARNESS | 12
16 | 2755221-0000 | SWITCH W/CABLE ASSY | 1
17 | 2021081-0000 | WRAP,SHRINK,1/2 | 10
18 | 2755413-0000 | JUMPER,2 POLE,3/8 CENTER | 4
19 | 2021241-0000 | WRAP,SHRINK,3/4 | 8
20 | 2755238-0000 | DIODE HARNESS,LARGE CONNECTOR | 5
TO BUZZER (3526807-0000)
ASSEMBLY NO. 3526800-0000
ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT
LIGHTING/WIRING ASSY,TMA 9182
NEXT ASSEMBLY 3526820-0000
MATERIAL SEE PARTS LIST
TOL ANGULAR: ± 1°
TOL LINEAR: ± 1/16" UNLESS OTHERWISE SPECIFIED
DRAWN D. Hayes Jr. 8/23/2004
DESIGNED R. Brougher 6/1/2004
CHECKED J. Espinoza 10/8/2004
APPROVED R. Brougher 10/8/2004
Q.C. S. Trageser 10/8/2004
SCALE N.T.S.
DRAWING 3526800-0000
SHEET 1 of 3
REV B
FILE 3526800-0000
Revisions
PCN 1931 2008
Date 1/11/04 6/3/05
Rev A B
By DPH DPH
Chk. JME JME
App. RCB RCB
Q.C. STT STT
ITEM 15 QTY WAS 16, ITEM 9 QTY WAS 4
ADD #19 & 20,#17 QTY WAS 4,#15 QTY WAS 17





DETAIL A
SCALE 1:1



DETAIL B
SCALE 1:1

ASSEMBLY NO. 3526800-0000

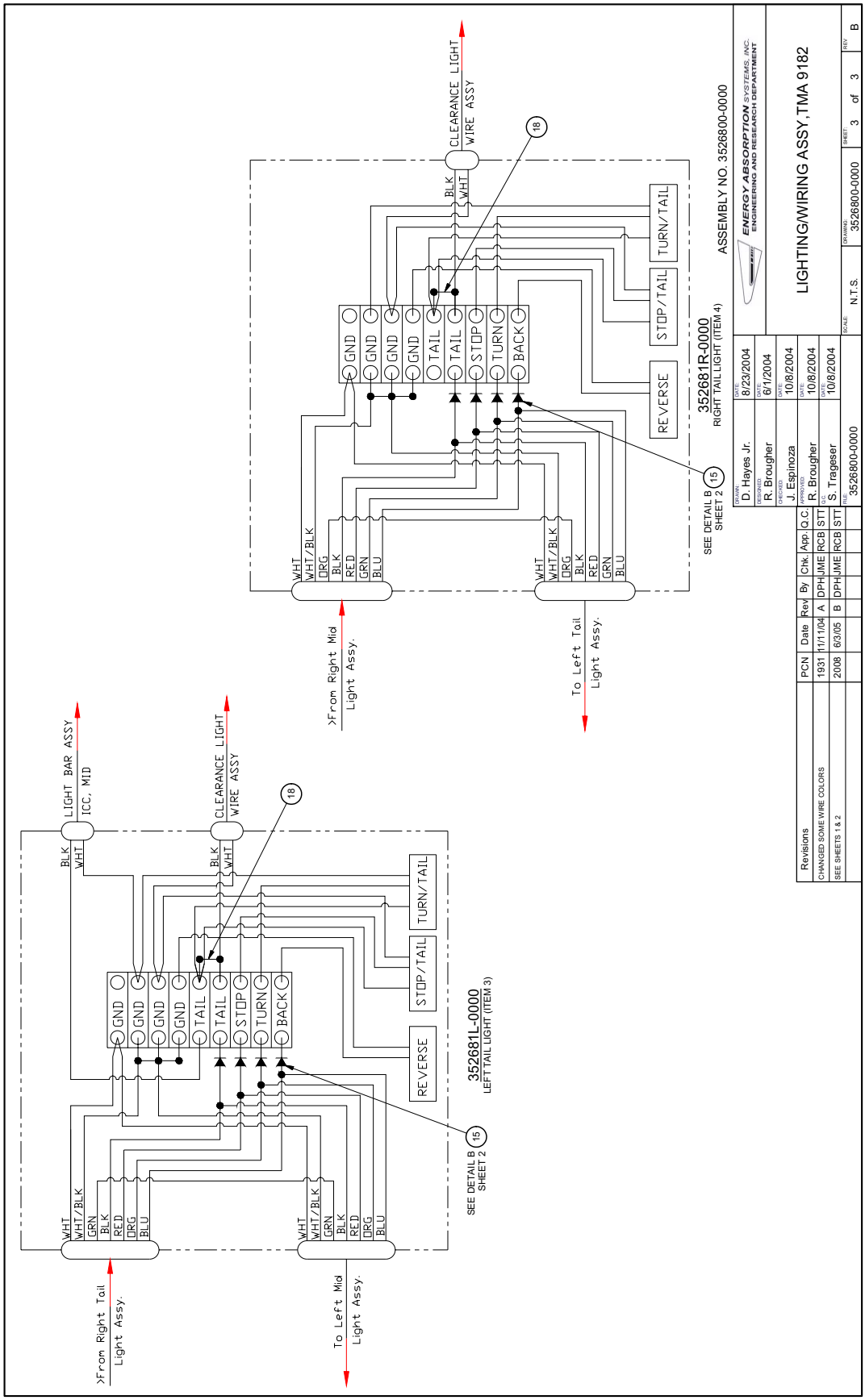
Revisions	PCN	Date	Rev	By	Chk.	App.	Q.C.
CHANGED SOME WIRE COLORS	1931	11/11/04	A	DPH	JME	RCB	STT
ADDED #20	2008	6/3/05	B	DPH	JME	RCB	STT

DRAWN	D. Hayes Jr.	8/23/2004
DESIGNED	R. Brougher	6/1/2004
CHECKED	J. Espinoza	10/8/2004
APPROVED	R. Brougher	10/8/2004
Q.C.	S. Trageser	10/8/2004
FILE:	3526800-0000	

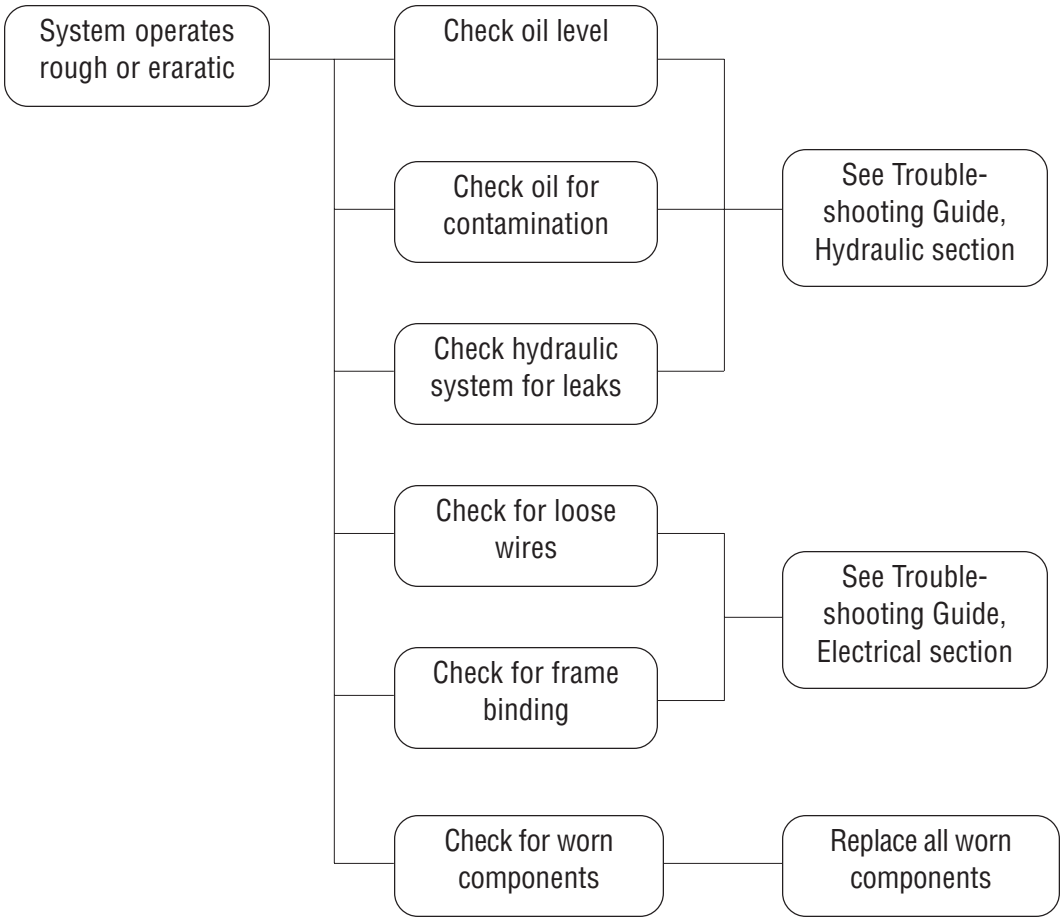
ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

LIGHTING/WIRING ASSY,TMA 9182

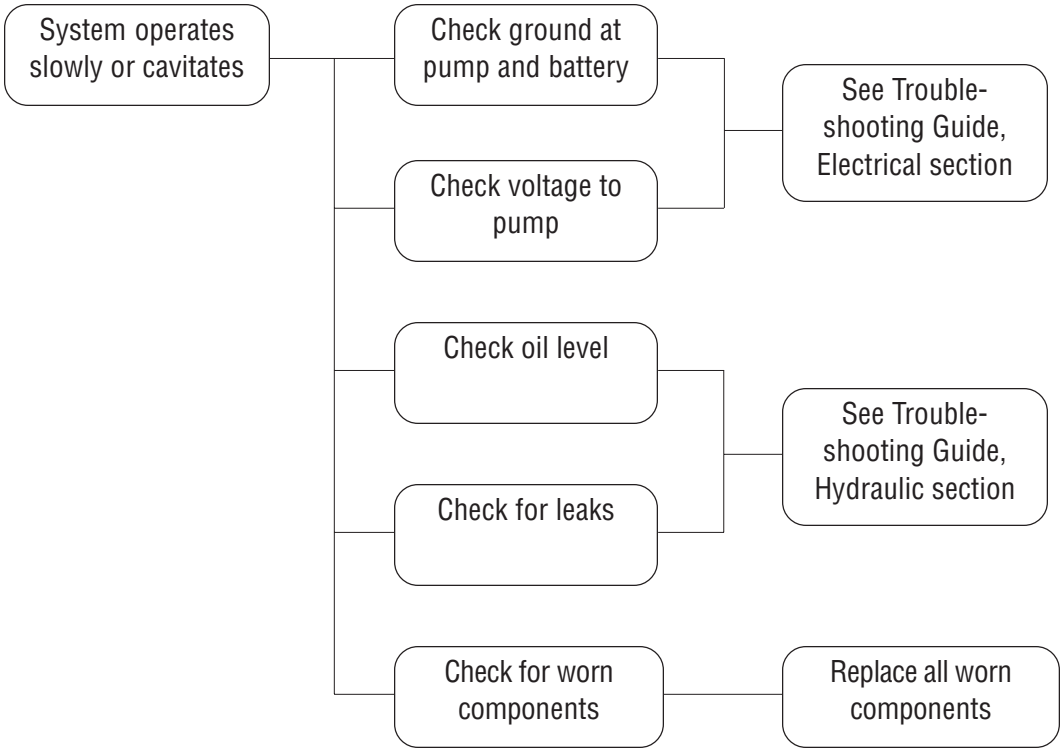
SCALE:	DRAWING	SHEET:	REV
N.T.S.	3526800-0000	2 of 3	B

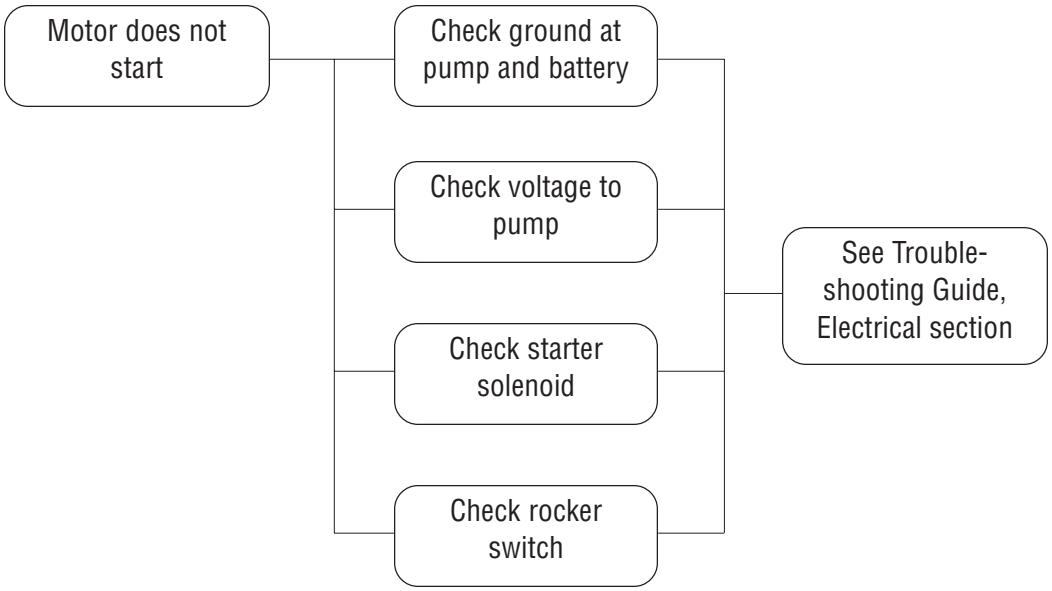

LIGHT BAR ASSY
ICC, MID
CLEARANCE LIGHT
WIRE ASSY
BLK
WHT
18
GND
TAIL
STOP
TURN
BACK
TURN/TAIL
STOP/TAIL
REVERSE
WHT
WHT/BLK
GRN
BLK
RED
ORG
BLU
>From Right Tail
Light Assy.
To Left Mid
Light Assy.
SEE DETAIL B
SHEET 2
15
352681L-0000
LEFT TAIL LIGHT (ITEM 3)
>From Right Mid
Light Assy.
To Left Tail
Light Assy.
352681R-0000
RIGHT TAIL LIGHT (ITEM 4)
ASSEMBLY NO. 3526800-0000
ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT
LIGHTING/WIRING ASSY,TMA 9182
DRAWN D. Hayes Jr. 8/23/2004
DESIGNED R. Brougher 6/1/2004
CHECKED J. Espinoza 10/8/2004
APPROVED R. Brougher 10/8/2004
QC S. Trageser 10/8/2004
SCALE N.T.S.
DRAWING 3526800-0000
SHEET 3 of 3
REV B
Revisions
PCN Date Rev By Chk. App. Q.C.
CHANGED SOME WIRE COLORS 1931 11/1/04 A DPH JME RCB STT
SEE SHEETS 1 & 2 2008 6/3/05 B DPH JME RCB STT
ASSY 3526800-0000

Quick Reference Troubleshooting Guide

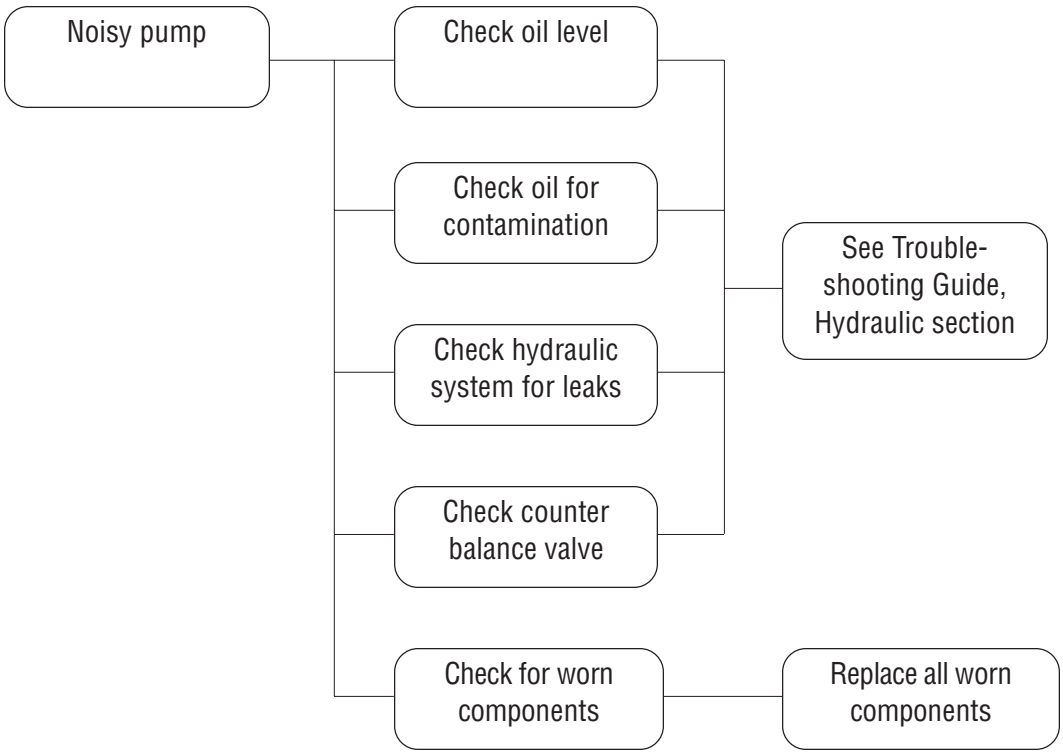

System operates rough or eraratic
Check oil level
Check oil for contamination
Check hydraulic system for leaks
See Trouble-shooting Guide, Hydraulic section
Check for loose wires
Check for frame binding
See Trouble-shooting Guide, Electrical section
Check for worn components
Replace all worn components

Quick Reference Troubleshooting Guide


System operates slowly or cavitates
Check ground at pump and battery
Check voltage to pump
See Trouble-shooting Guide, Electrical section
Check oil level
Check for leaks
See Trouble-shooting Guide, Hydraulic section
Check for worn components
Replace all worn components


Motor does not start
Check ground at pump and battery
Check voltage to pump
Check starter solenoid
Check rocker switch
See Trouble-shooting Guide, Electrical section

Quick Reference Troubleshooting Guide



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Rev. 3/13/06

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